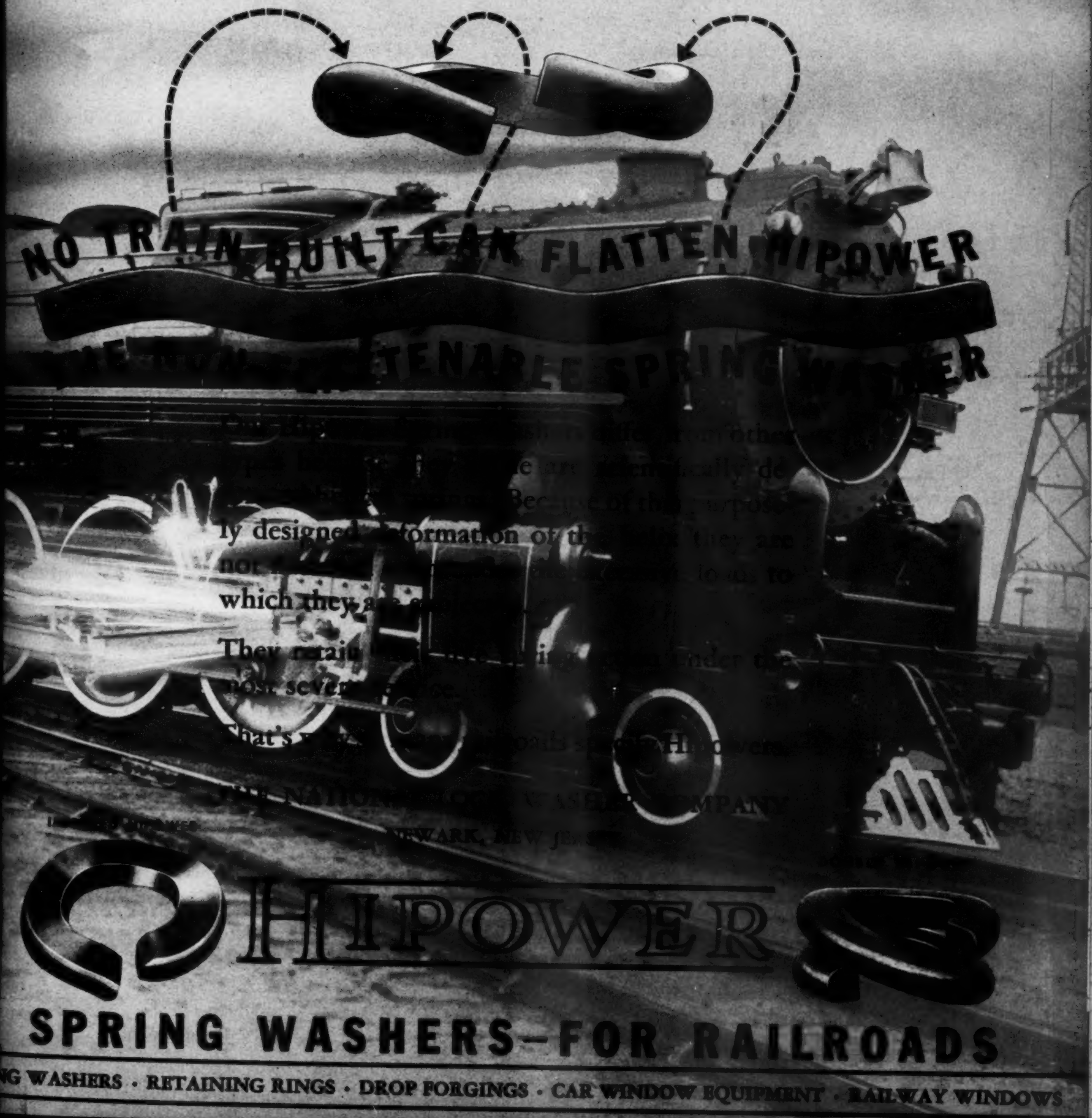
RIDGE AND BUILDING CONVENTION NUMBER NOVEMBER, 1938

Railway Engineering and Maintenance



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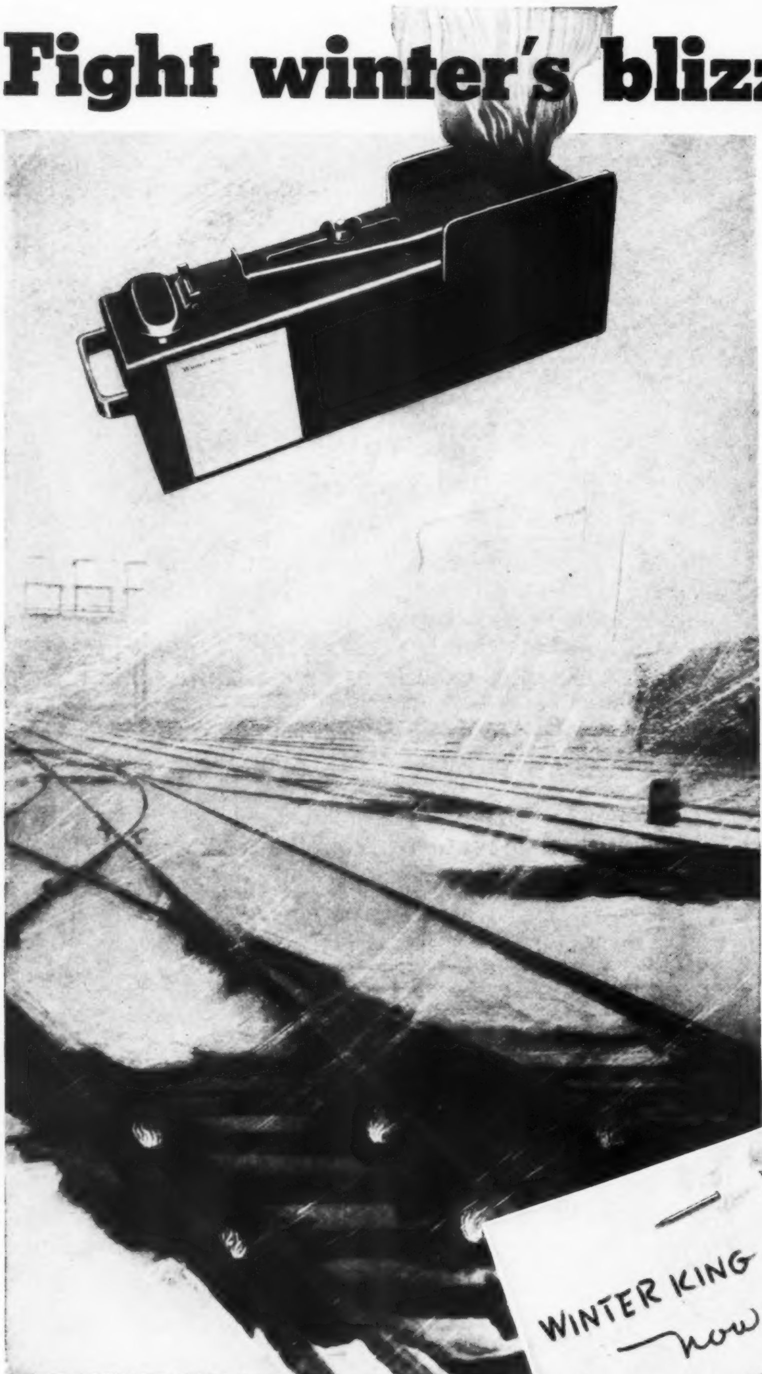
Fight winter's blizzards now

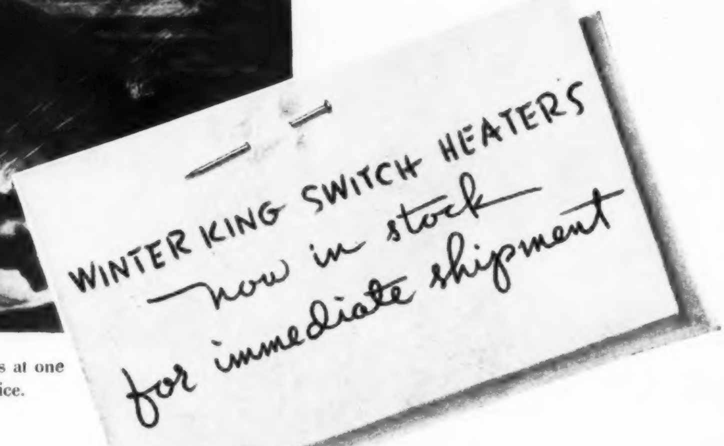


16 inches of snow in 1½ days didn't bother the switches at one large terminal where 4,000 Winter Kings are in service.

THIS is the month to make final check on your snow-fighting equipment. Among other things, check your stock of Winter King Switch Heaters. These are the inexpensive, efficient tools for keeping switch points and frogs clear of ice and snow.

Winter Kings ordered now can be delivered promptly—in plenty of time to distribute and install before the first sign of snow. Once this is done, you are set for whatever snow or ice may come along. Simply light Winter Kings, and switches stay open. One man can take care of about 100 heaters; fuel cost (kerosene) is only a few cents a day; the heaters themselves cost less than four dollars each.

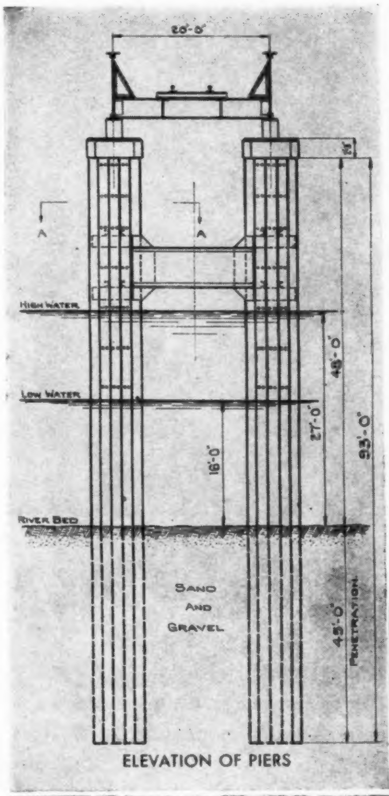
While we try always to have enough Winter Kings on hand to give prompt delivery, our experience shows once snow is forecast, orders do pile up. The safe thing to do is check your inventory now—and put through your requisition for Winter Kings without delay. Fight this winter's blizzards before they start!



BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

MZ-38 Piling Builds Railroad Bridge Pier *at a 60% Saving!*



ELEVATION OF PIERS

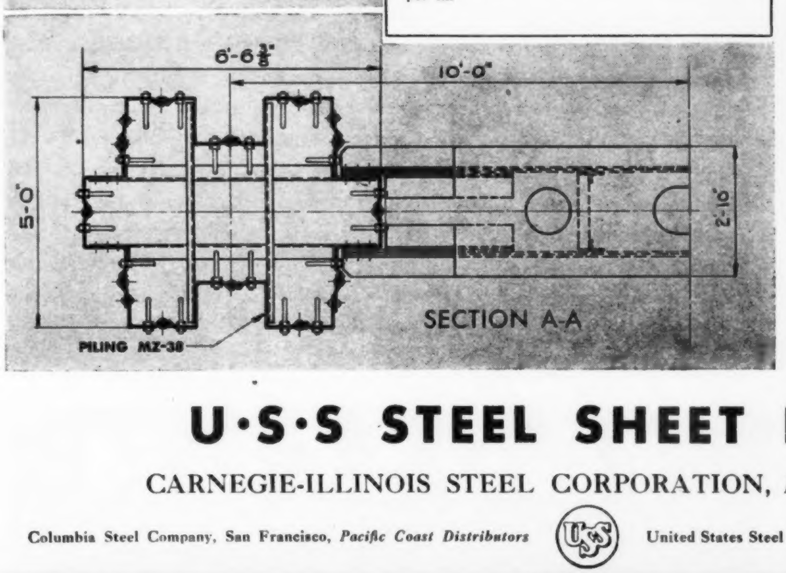
IN these two twin piers, U·S·S Steel Sheet Piling MZ-38 proves its versatility by doing an exceptionally fine bearing pile job at a 60% saving over the cost of one center mass pier for two truss spans.

Each twin pier supports a total superimposed load of approximately 2,000,000 pounds. This is carried primarily by the sheet piling, supported by skin friction in the sand and gravel which is adequate to support entire load. Each MZ-38 Pile, including the corners, supports an average of 42 tons. (Although piers were concrete filled after sheet piles were driven, no bearing value of the concrete on the enclosed sand is necessary for support of the loads.)

Sheet Piling pier construction like this has the double advantages of maximum speed and minimum cost. It requires no cofferdam, no form work, no excavation. Involves no delay in construction, offers minimum obstruction to stream flow. And in addition it provides a practical construction to take care of very deep scour conditions at least expense.

U·S·S Steel Sheet Piling is available in the most complete range of dimensions and sections — straight-web, arch-web and the new "Z" sections illustrated here. Call on us for helpful cooperation of our piling specialists — they may be able to save you money too.

River bed at the bridge site is glacial drift about 150 ft. to rock and consists of sand, gravel, clay and large gravel. River scour is about 15 feet at site. The MZ-38 Piling in 93 foot lengths was driven to a depth of 45 feet by a McKiernan-Terry Hammer to a resistance of 20 to 25 blows per in. for the last 5 feet, and for the last foot, 30 blows per in.



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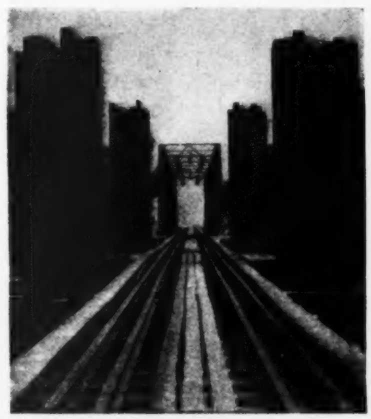

NO INTERRUPTIONS! **By placing each pier outside the clearance line, both twin piers were built without any interruptions of traffic. This type of construction is independent of water hazards because it is built in small units which are readily handled in swift water or where stream is subjected to rapid and considerable fluctuations of stage as was the case here.**

U·S·S STEEL SHEET PILING

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*

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Railway Engineering and Maintenance

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NOVEMBER, 1938

Railway Engineering and Maintenance

A Crisis

An Industry Faces Disaster

THE railways comprise one of America's greatest industries. They rank second only to agriculture in the magnitude of their activities. Their operations extend into every corner of the country. They provide a service that is vital to the prosperity, and, in most cases, to the very existence of other industries, including agriculture. Yet the railways are in dire straits today. Their situation is more critical than ever before experienced—a situation that threatens their very existence as private enterprise.

Efficient Performance

And this situation is not due to any inherent defect in the railways' method of doing business, for the railways are today carrying the major part of the commerce of the country—at a cost of only a cent for transporting a ton of freight one mile, a cost far below that of any other agency of transportation.

Nor is the difficulty due to any deterioration in service, for the railways are providing faster, safer and more dependable service today than ever before. The difficulties are not due to any decline in efficiency, for, measured by any unit, they are today producing transportation more efficiently than ever before and far more efficiently than any competing agency.

The difficulties are not the result of any increasing burden of capitalization, for the stocks and bonds have declined from a total of approximately $987 for every thousand dollars invested in railway properties 25 to 30 years ago to $721 today. If railroad debt alone is considered, the total has declined from 60 cents for each dollar of investment to 44 cents. Neither are the difficulties due to a rising burden of fixed charges, or interest due on bonds, for these charges took only 15.3 cents of each dollar of rail revenue last year, an amount smaller than in the years of greatest railway prosperity.

The crisis confronting the railways today does not arise from any of these conditions, for the railways have measurably improved their performance in all these respects. On the contrary, it arises from the simple fact that income and expenses have failed to maintain their normal relationship. On the one hand, the revenue received by the railways for hauling a ton of freight a mile is only about one-third more than in 1916, while the return earned by hauling a passenger a mile is actually less. On the other hand, the costs of the materials used and of the labor employed in railway service have increased by a greater ratio, with the result that the margin between income and expenses has not only declined below the level necessary to maintain solvency but has disappeared entirely in recent months. This is the situation that has precipitated the present crisis.

Expressed in simple terms, the operating revenues of the Class I railroads (those with total income exceeding $1,000,000 a year) averaged $6,970 per mile of line in the first half of 1938, while their operating expenses totaled $5,673 per mile. Their net operating income averaged $299 and their "other income" $291 per mile, bringing their "total income" available for fixed charges and dividends to $590 per mile. This total was short of the amount necessary to meet the fixed charges by $772 per mile of line for the first half of this year.

The railway crisis may be expressed in still another way. The net income earned by the roads in the six years from 1932 to 1937, inclusive, totaled $108,000,000. Yet, in the first half of 1938, the railways earned a net deficit of $181,000,000. In other words, in the first six months of this year the deficit wiped out all the net income of the preceding six years and more. This deficit accrued at the rate of a million dollars a day.

A Shrinking Industry

A further comparison illustrates what is happening to the railways. In the first seven months of 1929, the railways earned net operating income of $686,400,000; in the first seven months of 1932, this figure was $124,-000,000. In the first seven months of 1933, it totaled $217,000,000 and in the first seven months of 1938, it

declined to $109,000,000, the smallest of the depression.

This condition is bringing about a shrinkage within the railway industry that is most disconcerting. Compared with 1929, the railways of this country now have 10,000 fewer miles of lines, 600,000 fewer freight cars, 13,000 fewer locomotives and 12,000 fewer passenger cars. And these facilities are still decreasing. In the first seven months of this year, purchases of equipment and materials were 62 per cent, or $371,000,000, less than in the same period of 1937 and 74 per cent less than in the corresponding months of 1929.

And this decline has not been confined to materials and equipment. It has taken its toll also among employees, as every person still in railway service appreciates, for more than 800,000 persons who formerly looked to the railways for their livelihood have lost their positions during the last ten years. Of these, nearly a quarter million came from the maintenance of way department.

All these figures demonstrate the acuteness of the railway situation. They threaten the stability of the industry and the permanence of employment of those still on railway payrolls. Its future and their future are at stake.

The Solution

The solution lies in appreciation by the public that the railroads comprise a business and that, as a business, they should be allowed to operate as other businesses operate—with reasonable freedom to price their product, to adjust their facilities and services to business needs and their expenses to their necessities—and with fair and relatively equal conditions of competition and regulation with other agencies of transportation.

In the effort to bring about this objective, railway employees have a stake larger than that of any other party at interest, for they derive the larger part or all of their livelihood from this industry. More than half of the railways' operating revenues go to employees; as railway earnings increase payrolls grow. Every employee has a very direct personal interest, therefore, in promoting the solvency of his road and of the industry of which his road is a part.

The employee can make a very definite contribution to this objective by disseminating the facts regarding this situation among all those with whom he comes in contact, in order that these persons, when informed, may join in demanding a more liberal attitude towards the railways. If the 930,000 employees still on railway payrolls interest themselves in such activities, their influence will go far to bring about a solution of the problem that is now so acute.

Treated Timber

Far Behind in Building Use

FOR 100 years the railways have been familiar with the preservative treatment of wood for ties; for 75 years they have been treating piles and timbers for use in piers, docks and other structures to be built in waters infested with marine borers; for more than 50 years it has been common practice to treat piles and timbers for bridges. So widespread is this latter practice that today, on not a few roads, untreated material is never used in bridge construction, except for temporary structures and falsework. In addition to these applications of treated timber, this material is being used for many other purposes and the railways are constantly finding new applications.

What is the record with respect to buildings? Despite the intimate knowledge the railways have acquired concerning the economies and other benefits that can be effected through the use of treated timber, by reason of their consistent use of this material over a period of 100 years, it has as yet been little used in buildings. This is a strange inconsistency, particularly in view of the fact that the railways have always used an overwhelming proportion of the timber that is given preservative treatment. While they have led in its adaptation for practically all other purposes for which it is used today, they have been strangely reluctant to adopt it for building construction.

Apparently inertia has been an important element in this failure to take advantage in building work of the economies that preservative treatment has demonstrated in other applications. On the other hand, the reasons most often advanced for failure to apply preservative treatment to building timber are that the odor of creosote is objectionable, that creosoted wood stains other wood and plaster in contact with it, and that it cannot be painted. That these are not insuperable objections is demonstrated by the fact that there are other preservatives equally adapted for the treatment of building lumber that are odorless, that do not stain and that are effective in protecting the wood against decay and insect attack. Lumber given a "clean treatment" with these preservative salts can be painted with the same facility as untreated wood. This means that either creosote or any of these preservative salts can be used to treat the material below the floor line, and that a "clean treatment" can be applied to that for use above the floor line.

When it is considered that the railways maintain approximately 370,000 buildings of all types; that the majority of them are of frame construction, and that wood is employed to some extent in all of them; and that in normal times the railways spend more than $90,000,000 a year for building maintenance, it is not difficult to visualize the economies that can be effected through the use of treated lumber in building construction. Some building officers who would otherwise look with favor on the use of treated timber for building work foresee difficulties in doing so. They recognize that to get the full benefit of the preservative treatment the lumber should be preframed; yet they say that many buildings are erected under authorizations that demand such early completion of the projects that time is not available for either the preframing or the treatment of the material.

Obviously, the correction of this situation demands the exercise of more foresight on the part of management; that it can be overcome is evidenced by the fact that several roads are now treating lumber for building construction, while on one of these roads, every piece of timber that is treated for building work is preframed. Only a few years ago, somewhat similar objections were raised to the preframing of bridge timber, some of which were found by experience to have been imaginary, while others that were real have been overcome and today not a few roads are preframing all bridge timbers. The preparation of timber for other uses gives no reason to believe that the preparation and treatment of lumber for buildings offers any insurmountable difficulties.

Putty

What Causes It To Fail?

A RECENT casual inspection of several railway buildings in which much deferred maintenance was evident, disclosed that the putty had cracked and crumbled and fallen from many of the windows and that in a few instances the glaziers points that remained were the only means of retaining the glass in place. This brings up the causes of putty failures and the means for overcoming them. Putty is a mixture of pure whiting and pure linseed oil, and to be dependable should contain no adulterants or substitutes.

Extreme care should be exercised in the selection of the putty or of the constituent materials. Commercial putty is often of inferior quality; marble dust is sometimes added to whiting to increase its weight; and inferior oils tend to dry, causing the putty to crack and fall out; while if petroleum is used as an adulterant the putty will crumble when it comes in contact with water. Poor materials by no means constitute the only defect in putty as applied, for many failures can be traced directly to faulty workmanship. If the wood surfaces to which the putty is applied are not clean or the wood is well dried out, it will be difficult to get the putty to adhere to them.

To prevent this, the rebates should be cleaned thoroughly and painted with white lead and linseed oil thinned to a priming consistency. The paint should be allowed to dry, after which a thin layer of putty should be spread uniformly on the bottom of the rebate and the pane of glass should be pressed firmly into it to obtain an even bearing. Then, without releasing the pressure on the glass, glaziers points should be inserted at about 6 in. intervals to hold the glass in place. The rebate should then be filled, but not overfilled, with putty, pressing it gently but firmly into place and then smoothing.

Dry wood will absorb oil from the putty, causing it to crack and crumble, this being the reason why the painting of the rebates just prior to the glazing of the sash is so important. As a further protection, it is desirable that the outer surface of the putty be painted with lead and oil when the sash is painted. If the building is subject to vibration, it may be desirable to add about 10 per cent of white-lead paste to the putty, as this will toughen it and increase its adhesion to the wood. More than this will cause the putty to become extremely hard and will increase the bond with the wood to such an extent that it cannot be broken without causing damage to the muntins.

These seem to be small and unimportant details, yet it was the neglect of some or all of them that caused the conditions which were cited in the beginning.

Winter Ahead

Are You Prepared To Meet It?

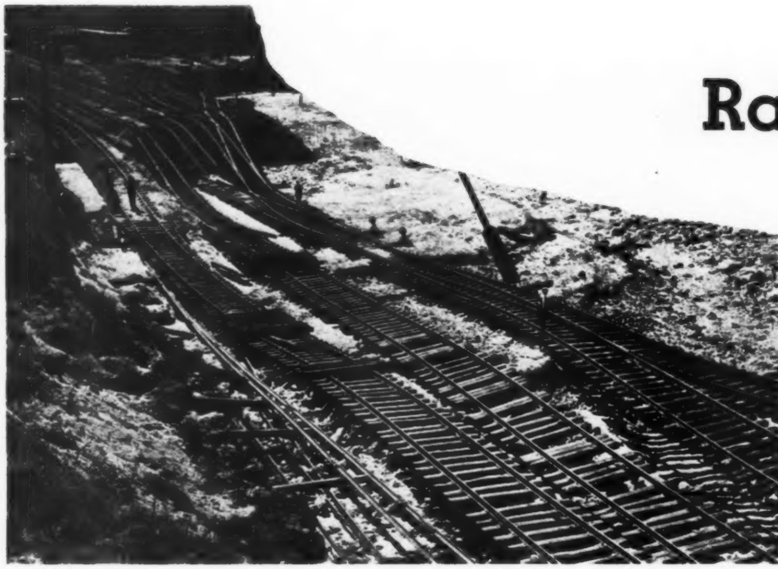
WITH so much routine maintenance work still to be done, due to a combination of circumstances with which railway men are only too familiar, maintenance officers face the fact that winter is not far ahead. It is foolhardy to recall that the last two winters were relatively open in many sections of the country, and to live in the hope of another such winter. In fact, this very situation, with its limited use of special winter forces and equipment during the last two years, suggests that increased attention be given this year to preparations to insure that the forces are keyed to the possibilities of a severe winter and that equipment, long idle, has not been mislaid or is not out of working condition.

Every maintenance of way man in the northern parts of the country knows that it is costly to cope with a severe snowstorm, unprepared. However, it is not so much what they know, as it is what they do about it. This is an important point to raise at this time when so many maintenance men are still trying to close up summer and fall programs; are busy studying and analyzing their requirements for the coming year; and are exercising every means to keep maintenance of way expenses to a minimum.

Many quite plausible excuses can be offered for putting off the obvious necessity for giving immediate attention to preparing for winter storms, but none of them is valid for failure to meet the emergency of a storm. From the standpoint of economy, one should not overlook the fact that each dollar spent now may save many dollars later.

For the track department, preparedness requires the preparation of the track, cuts, ditches and culverts for winter, with special consideration to points most vulnerable to snow and ice; it requires the completion or checking of arrangements with the weather bureau and the personnel over the road for advance warnings of approaching storms; it requires the checking of all snow-fighting equipment and tools to insure that they are available in sufficient quantities, are spotted or housed at the most strategic points, and are in good condition; it requires that such materials as salt, sand and snow-melting oils be on hand and properly distributed and stored; and of greatest importance, it requires the most careful advance organization of forces so that, automatically, these forces will swing into action with the assurance that every critical point will receive adequate attention, and at the time when it will be most effective.

With such preparedness, maintenance of way men, from the higher officers down to the section men, can go about their routine duties of the winter with the greatest efficiency, and with the assurance that they will meet their responsibilities when the occasions arise. Without such preparedness, almost anything can happen.



A Bad Washout Occurred at the Putnam, Conn., Yard of the New Haven

Railroads Battle

Striking with devastating effect, the excessive rains and high winds which swept New England late in September inflicted an appalling amount of damage on railroad property in the affected area. This article describes the extent and character of the damage sustained by the carriers and gives an account of the methods and equipment employed in restoring the various lines to service.

THE flood and hurricane which swept New England late in September destroyed property of the railroads of that region at least equal to and probably exceeding any loss heretofore experienced in this region. Damage attributable to flooded streams alone was comparable to that inflicted by either the 1936 or the 1927 floods, and when to this destruction was added that caused directly and indirectly by the hurricane, it became a major disaster.

The storm had its beginning in four days of excessive, and in some cases record, rainfall throughout New England, which began on September 17. As a consequence, by September 20, the destructive effects of flooded streams on railroad property began to manifest themselves at many locations, and, as the rains were continuing, it was becoming evident that serious trouble was ahead. When the railroads were beginning to marshall their resources to cope with the flood menace, the hurricane struck on the afternoon of September 21, bringing with it further rainfall and adding greatly to the destruction already in progress.

The tropical hurricane struck the southern coast of New England over practically its entire length, bringing with it wind velocities approaching 100 miles an hour in some places. As it moved forward the gale piled up a tidal wave which engulfed railroad shore and terminal properties all along the line, flooding stations, damaging numerous bridges and washing out many miles of trackage, particularly along the Shore line of the New York, New Haven & Hartford. Except for this line, however, track and bridge washouts were due mainly to flooded streams. As the hurricane passed into the interior, it blew down freight houses, ripped roofs and canopies from passenger stations and other structures, broke windows, tore down communication lines and signals and strewed the tracks with trees, poles, parts of buildings and debris of every description.

As the stream flows were augmented still further by the additional rainfall accompanying the hurricane, they rose even higher. Although the larger rivers, such as the Connecticut and the Merrimack, did not quite reach the heights attained in 1936, many of their tributaries and other smaller rivers and streams rose far beyond the records established two years ago and it was mainly along such streams that the principal damage to railroad property was inflicted, bridge and track washouts being numerous and extensive. As the full extent of the damage became apparent the forces and equipment of the affected railroads were quickly organized to cope with the emergency on a 24-hr. basis.

By far the greatest damage to the railroads in the storm area was sustained by the New Haven and the Boston & Maine. However, practically all other roads having property in the path of the storm suffered varying degrees of damage, those that were particularly hard hit including the Boston & Albany, the Rutland, the Central Vermont and the Long Island. Lines in New Jersey and lower New York were also affected but here the losses were comparatively small.

Damage on the New Haven

Because of the exposed position of its double-track Shore line, which parallels the New England coast for many miles, the New Haven bore the brunt of the damage inflicted by the tidal wave. The destructive efforts of this wave were concentrated principally between Saybrook, Conn., and Westerly, R. I., a distance of 36.2 miles; other sections of the shore were affected to a lesser extent. In this territory, the tidal wave surged over the tracks and washed out thousands of feet of trackage, displaced and damaged numerous bridges and covered the tracks with parts of buildings, boats and other debris.

At East Lyme and at Niantic, a half mile of both tracks was washed out to a maximum depth of 20 ft. Farther east, near Noank, considerable trackage was also badly washed and a concrete slab bridge on stone abutments (bridge 6.25) at Palmers Cove was

e Record Floods and Hurricane in New England

badly undermined. About 1½ miles east of Mystic, approximately 500 ft. of track were destroyed and the abutments of bridge 10.73, an 18-in. I-beam span, were badly undermined. A half mile farther east 1,000 ft. of both tracks were carried off the embankment and also off bridge 11.21, a 57-ft. deck plate-girder span. Scour under the west abutment of this structure caused considerable settlement, while the east abutment was undermined to a lesser extent.

Still farther east near the Stonington, Conn., station considerable additional trackage was severely affected and between Stonington and Westerly another washout occurred involving nearly a mile of track. At this point bridge 14.48, a 70-ft. through plate girder span on stone masonry abutments was damaged severely, both abutments being undermined and the girders being displaced to such an extent that one of them was hanging unsupported practically in mid-air.

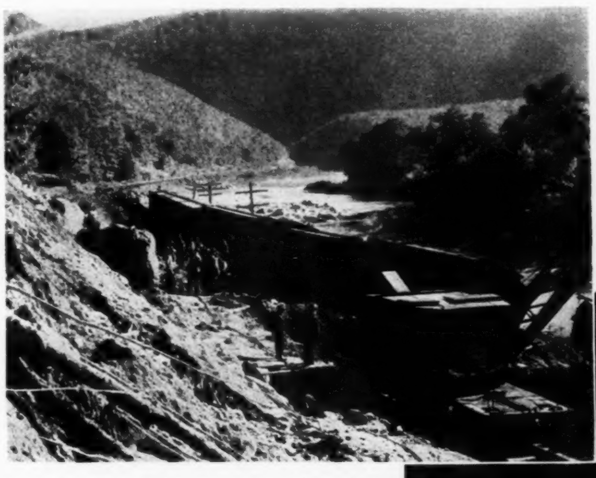
Other Lines Affected

While the Shore line was being cut in numerous places, lines elsewhere on the New Haven were being literally riddled with washouts due to flooded streams and rivers. Damage on other lines included extensive washouts between Manchester, Conn., and Willimantic; between the latter point and Plainfield; and between Middletown and Putnam; while the yards at both Willimantic and Putnam also suffered severe washouts. Other lines on which extensive damage occurred included those between Fall River, Mass., and Newport, R. I., Buzzards Bay, Mass., and Woods Hole; Webster, Mass., and Southbridge; Cornwall Bridge, Conn., and Pittsfield, Mass.; Waterbury, Conn., and Devon; East Providence, R. I., and Bristol; Tremont, Mass., and Fair Haven.

Because of the conditions described above, all trains on the New Haven were annulled on the afternoon of September 21, although service on the four-track electrified line between New York and New Haven, including the Harlem River and New Canaan branches was restored quickly following a temporary loss of power. During the following 24 hours, a number of additional lines were opened to traffic, including that between New Haven and Hartford; that between Hartford and Ansonia, Conn.; much of the Boston division; and a number of branch lines. Elsewhere the damage was more extensive and resumption of service had to be postponed considerably longer pending repair of the tracks and bridges.

Restoration work on the New Haven was directed principally towards the resumption of through service between New York and Boston, and to this end a large concentration of men and equipment was put to work on the Shore line, although repair work elsewhere on this company's lines went forward with all possible speed. On the Shore line, crews working east from New Haven soon had the line open as far as Saybrook, while other crews working west from Providence quickly had the line open as far as Westerly. Hence by September 23, it was possible to operate eastbound passenger trains from New York as far as Saybrook and from Boston as far as Westerly, in both directions, the gap of 36.2 miles between these two points being bridged by buses.

By September 26, a single track had



On the B. & M. —Left—A Slide Near Zoar, Mass. Below—A 100,000 Cu. Yd. Washout Near Millers Falls, Mass.

been opened from Saybrook to New London, thereby narrowing the gap to about 18 miles. On October 4, or 13 days after the line went out, a track was opened for traffic between New London and Westerly, permitting the resumption of through-all-rail service between New York and Boston.

Restoring the Shore Line

The repair operations on the Shore line between Saybrook and Westerly involved considerable bridge work, which consisted largely of the driving of pile bents for the support of temporary or existing spans at the four locations mentioned previously, and in carrying out this work bridge crews, using locomotive cranes with steam hammers, worked from both directions. In addition a contractor, equipped with a crawler-mounted steam pile driver, was put to work at an intermediate point, bridge 11.21.

Track gangs, augmented by hundreds of additional employees, attacked the damaged section of track on the Shore line from both directions and also at intermediate points. Other measures for expediting restoration work in this section included the hiring of a local contractor, equipped with a truck-mounted gasoline shovel, to clear debris from the tracks in the vicinity of Mystic and also to haul gravel by truck to points that were inaccessible by rail.

To aid in the restoration work on the Shore line, four local bridge gangs were augmented by eight bridge gangs from other points on the New Haven and also by four bridge repair crews supplied by a contractor. During the peak of the emergency work the railroad had about 700 extra employees on the Shore line alone. Including regular employees, the total number of men working on this line at the height of the emergency amounted to about 1,000, including both track and bridge crews.

For housing and feeding the large concentration of men on the Shore line, two camps were established, one at Midway, Conn., just east of New London and the other at Guilford, Conn., 16 miles west of Saybrook. To co-ordinate and expedite work on this line a temporary field headquarters, in charge of a representative of the engineering department, was established at New London and, to make it possible for this office to keep in constant touch with conditions and the progress of the work in the field, a private telephone circuit was set up, with connections at each bridge location.

At Niantic, Conn., the Shore Line of the New Haven Was Badly Damaged by the Tidal Wave

Track and Bridge Repair Crews at Work on the New Haven's Shore Line Near Lords Point, Conn.

During the emergency repair work on its Shore line as well as elsewhere on the system, the New Haven utilized trucks extensively for transporting men, materials and equipment. Because it would have been next to impossible to obtain a sufficient number of private trucks for this purpose, the railroad feels that its track maintenance organization, which utilizes highway trucks extensively for transportation purposes, proved a distinct asset in helping to cope with the emergency.

Pending restoration of through rail service over its Shore line, the New Haven was faced with the task of establishing an alternate route for freight traffic between New Haven and Boston. To this end repair work was pushed vigorously on the Air line, which extends northeasterly from New Haven through Willimantic, and also on the other lines radiating from Willimantic. In this phase of the operations, work trains converged on Willimantic from New Haven, Hartford and Putnam, repairing the track as they proceeded. Meanwhile repair of the yards at Willimantic and Putnam was undertaken by local forces with the aid of contractors who were engaged to haul in filling materials by truck. Another contractor aided in the restoration of the Willimantic-Providence line by hauling material to points that could not be reached by rail.

As a consequence of these efforts, it was possible to open the Air line for the movement of freight on September 28, while on the same day service was inaugurated on the Hartford-Willimantic line. Shortly thereafter, on October 1, the Willimantic-Providence line was placed in condition for service and as the repair work gained headway at various points, additional lines were rapidly restored to service.

In the repair work on the New Haven, a total of 5,000 cars of gravel and stone were used, and the acquisition and transportation of this material proved to be one of the most important aspects of the restoration work. To insure that gravel pits and quarries would be supplied with the requisite number of empty cars at all

times and to co-ordinate and expedite the movement of loaded cars to their destinations, two transportation assistants were maintained on duty in the chief engineer's office on a 24-hr. basis throughout the emergency.

Many buildings on the New Haven, as well as communication lines and other facilities, were either damaged or destroyed altogether by the hurricane. In the latter classification may be included freight house B at New Haven and the freight houses at Windsor Locks, Conn., Norwich and Putnam. Moreover, the roof was torn off the passenger station at Providence and also from the Charles Street enginehouse at the same point. Severe damage was sustained also by the Southampton Street enginehouse at Boston, by buildings at the Readville, Mass., shops, by the wharf properties at Providence, and by numerous frame stations and small buildings.

Damage Widespread on B. & M.

On the Boston & Maine, as on the New Haven, the damage inflicted by the combined efforts of the floods and the hurricane was severe and widespread, and it is estimated that the property loss on this road, exclusive of traffic and other losses, will amount to $2,200,000. Although this company's lines were not exposed to the destructive effects of the tidal wave, they appeared to be the particular target of flooded rivers and streams which inflicted the greatest part of the damage. At the height of the storm, about 1,165 miles of this company's total of 1,960 road miles of line were inoperative, but so quickly and effectively were restoration measures carried out that the lines out of service had been reduced to 250 miles by October 1, and as this issue goes to press all lines, with the exception of a few unimportant branches, have been restored to service.

On this road the greatest damage was sustained by the company's principal east-west main line, namely the double-track heavy-duty line extending between Boston, Mass., and Troy, N.Y., and Rotterdam Junction, which comprises the principal part of the Fitchburg division. Damage in varying degrees of severity was inflicted all along the line west of Fitchburg, Mass., but was concentrated principally in the territory between Gardner, Mass., and the east portal of the Hoosac tunnel, a distance of 70 miles. In the territory between Gardner and Greenfield, 31 miles, the tracks and bridges were literally effaced at many locations by the turbulent Millers river, which attained a height of 3.5 ft. above the level established in 1936.

Between Gardner and Greenfield, four major bridges were either badly damaged or destroyed altogether. At Otter river, four miles west of Gardner, both abutments of bridge 101, a deck plate-girder structure having a span of 38 ft., were undermined and partly washed out. A short distance farther west, bridge 103, a structure of similar design and dimensions, was entirely washed out, the steel being carried downstream and covered with sand. The hole in the roadbed at this point was 280 ft. in length and 40 to 50 ft. in depth.

Proceeding farther west, the center pier of bridge 134, a double-span deck plate-girder structure at Wendell, Mass., was washed out, and both abutments were undermined. Just east of this bridge, water pouring around one end of a dam in the river cut through the embankment and washed out a hole 325 ft. long and 30 ft. deep. At Irving, about two miles west of Wendell, bridge 137, a three-span deck plate-girder structure, 181 ft. long, was almost totally destroyed, the steel being carried downstream and the abutments and piers being either destroyed entirely or badly damaged. At Millers Falls, six miles west of Irving, the Millers river changed its course during the flood and cut a loop through the railroad's embankment, completely washing out the roadbed for a distance of 1,400 ft. and to a depth of about 30 ft. Numerous additional washouts and other forms of destruction occurred in this territory but the foregoing locations comprised the points of major damage.

Between Greenfield and the Hoosac tunnel severe washouts were also experienced and at bridge 178, a half-through plate-girder 90 ft. long, the center pier settled four feet and the east abutment was badly damaged. Trouble in this section was highlighted by landslides in the vicinity of Zoar, including two extensive slides which moved about 1,000 ft. down the mountainside. The larger of these buried the westbound track for 475 ft. to a depth of about 6 ft. Another portion of the Fitchburg division that suffered extensively was the Cheshire branch which was badly washed and flooded for practically its entire length.

Another part of the B. & M. that was hit hard by the floods was the New Hampshire division. The portion of this division most seriously affected was the main line between Concord, N. H., and White River Jct., Vt., where a total of about 30 washouts occurred. Other lines on the New Hampshire division that suffered extensively were those between White River Jct., and Wells River, Vt.; between Lowell, Mass., and Concord; and between Concord and Woodsville. Neither were the various branches of this division spared, particularly that between Worcester and Contoocook, which was exceptionally hard hit.

The Boston & Maine Lost Nine Major Bridges Between Greenfield, Mass., and the Hossac Tunnel. This is All That Was Left of a Bridge at Wendell, Mass.

To cope with the emergency, supervisory employees and laborers in unaffected areas of the B. & M. were drawn into the flooded districts and additional employees were hired wherever needed. During the height of the restoration work, a total of nearly 3,300 employees were engaged at various points, not including members of contractors organizations. Of the to-

tal number of employees, approximately 1,400 were extra men. The company borrowed two extra track gangs, one bridge crew, equipped with a pile driver, and a steam shovel from the Maine Central, and contractors were engaged to help in filling washouts, building trestles and for numerous additional tasks. To insure that men working away from their headquarters, as well as extra employees, would be adequately housed and fed, boarding-car outfits and commissary facilities were quickly organized at the various centers of activity.

This Bridge on the New Haven Near Stonington, Conn., Had To Be Held Up by a Derrick While a Rock-Filled Crib Was Sunk To Serve as a Temporary Support

Utilizing a wide variety of power equipment and tools, the foregoing organization was able to restore many lines to service in a short time, but in the Gardner-Greenfield sector, the work of restoration proceeded more slowly because of the extensive character of the damage, and it was in this district that most of the equipment, materials and men were concentrated. Work on the line between Greenfield and Gardner was carried out principally by two separate forces, one working west from Gardner and the other working east from Greenfield. A third force, with a work train, which happened to be marooned between these two points, rendered valuable service in restoring the track at intermediate points.

Work at Millers Falls

The force working from the west end had to cope first with the large washout at Millers Falls. Before the filling work could be started at this point, it was necessary to divert the river back into its normal channel by the construction of a sand bag dike. Next, a 400-ft. filling trestle was constructed from the west end on a three per cent grade and while this work was in progress, dumping operations were commenced at the east end of the washout, using highway trucks. As soon as a single track could be constructed across the washout at Millers Falls a work train, including pile driving equipment and carrying piles and bridge timbers, was dispatched to bridge 137 at Irving.

At this bridge, it was necessary to construct a single track trestle 250 ft. long for temporary operation. In building this trestle a track-mounted pile driver worked from the west end while a crawler-mounted unit operated from the other end, using piles and lumber hauled in by truck.

The emergency repair crew working west from Gardner first encountered bridge 101. Here the repair work consisted of the driving of temporary pile bents to support the existing steel, the underpinning of the abutments and the repair of the steel. Next, the outfit moved to bridge 103, where a temporary single-track trestle 330 ft. long was constructed. For accomplishing this work, a land pile driver was placed in operation in the bed of the stream where it drove foundation piles for frame bents. In the meantime, a track pile driver drove piles in the embankment slope at the west end while a crawler shovel, also operating in the stream bed, was engaged in removing the old masonry and in servicing the land driver with piles. To secure rapid framing of the bents for this structure, a wood mill, completely equipped with pneumatic saws, drills and other such necessary tools, was set up at the bridge location.

When the temporary structure at bridge 103 had been completed, the repair crew moved on to bridge 134 where a trestle 136 ft. long was constructed and the fill east of the bridge was restored. While the washout at the east end of this bridge was being filled, a crawler-mounted pile driver, which had been transported by highway trailer, began pile driving operations from the west end.

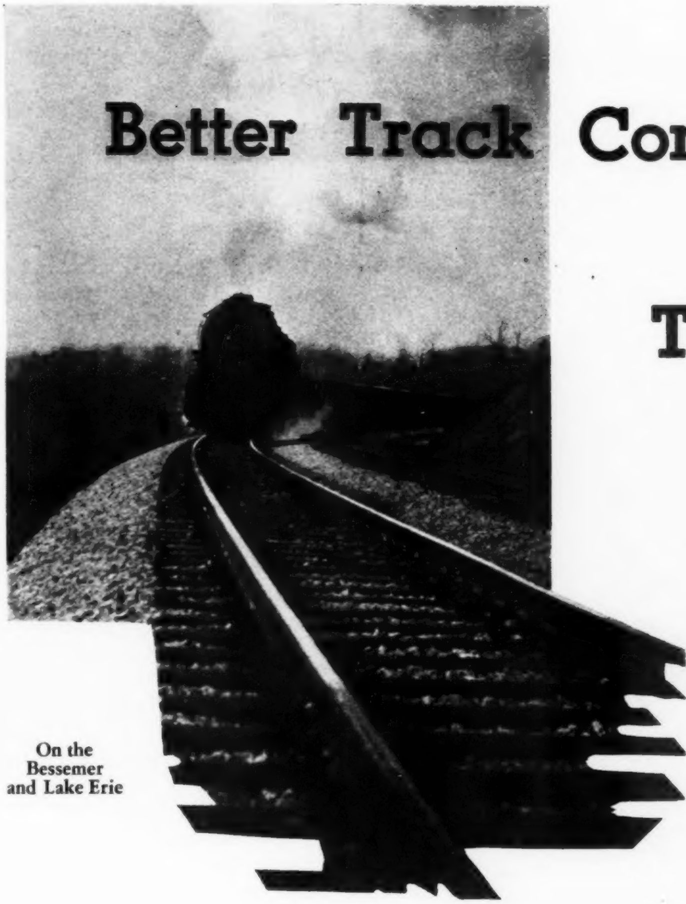
As a part of the emergency organization set up to cope with the situation, three temporary maintenance of way storekeepers were placed on duty in the affected area, one at Gardner, another at Greenfield and the third at Concord. All requests for trestle material were handled through the general storekeeper's office at Boston, the timber being supplied largely from stocks at Nashua, N.H., although some material was purchased locally. Local forces had authority to deal directly with commercial quarries and gravel pits, and a supply of crushed stone and rip rap was accumulated at Boston for use wherever needed. Quantities of materials consumed during the restoration work included about 375,000 cu. yd. of filling material, and about 350,000 tons of rip rap. Also approximately 1,800 lin. ft. of pile trestles were constructed.

During the early stages of the emergency on the B. & M., through eastbound freight traffic was turned over to the Delaware & Hudson and moved north on that company's lines to connections with the Canadian National or the Canadian Pacific, then being routed eastward over these and connecting lines to Portland, Me., and thence down the Portland division of the B. & M. to Boston. In fact, for about a week after the storm, this was the only railroad line into Boston that was open. As the various lines of the New Hampshire division of the B. & M. were restored to service, the rout-

(Continued on page 724)

Starting Emergency Repair Operations at a Bridge Washout on the B. & M. at Otter River, Mass.

Better Track Construction for Tomorrow's Traffic



On the Bessemer and Lake Erie

Addressing the Roadmasters' convention at Chicago, on September 21, Mr. Layng sees in the trend for higher speeds of both passenger and freight traffic, a demand for further improved and strengthened track materials and a higher standard of track maintenance. An abstract of his address, which calls for improved drainage, a stronger subgrade, better line and surface, deeper ballast, greater care of ties, and further study of rail and rail welding, is reproduced herewith.

By F. R. LAYNG

Chief Engineer, Bessemer & Lake Erie

It is rather difficult, during a severe business depression such as that through which we are passing and which has lasted over eight years, to forecast the future of the railroad business and to say with confidence what tomorrow's traffic may be. During these depression years many compromises had to be made. Much has been left undone that we hoped to accomplish. Nevertheless, even throughout this trying period progress has been made. During these years we have seen an amazing step-up in speed of both passenger and freight trains. We have seen the introduction of stream-lined trains, operating at speeds heretofore thought impossible and this is being done safely and with schedules regularly maintained, furnishing service that is the best our patrons have ever known.

While much study has been given to the possibility of changing the design of the track structure radically and some criticism has been expressed that railway engineers have been too slow in developing some new design, it is believed that the present track structure is basically correct and rests on sound engineering principles. The plain facts are that the present design is simple, efficient and admirably meets the demands of the service it is called on to perform. Throughout the years it has shown that it can be and has been adapted to constantly increasing axle loads, volume of traffic and increased speed. Its future development will likely continue along the general lines followed in the past, namely, a refinement of the several elements that go to make the complete track structure—and we will continue to develop better and more efficient methods of maintenance.

New Conditions

It seems clear, however, that there are several very definite influences that will affect the track structure in the future, such as the introduction of equipment built of light-weight materials and tending to reduce dead load, a continuing improvement in the design of locomotives and cars, which improvements will have as one of their objectives less damage to the track. On the other hand, this will be offset by substantial increases in average speeds. It is probable that for the future we can assume that the present maximum axle loads will not be greatly increased, but it seems fair to assume that we can confidently look for maximum speeds for passenger traffic up to 125 miles per hour and 60 miles per hour will be common for freight. Therefore, the future will demand a constant raising of our present track standards to the end that the materials making up the track structure will have the longest possible life and that unit maintenance labor costs will be further reduced.

The conditions outlined above will also demand carrying on maintenance operations so that there will be practically no interference with the free flow of traffic, because the slowing down of trains operated at these

higher speeds becomes increasingly expensive. For the same reasons the maintenance of slow orders over stretches of track that are either unsafe for scheduled speeds due to the need for replacement of worn materials or during the carrying on of current maintenance work must be avoided to a much greater extent in the future than has been considered necessary in the past. It is also true that any failure in the track, because of these high speeds, may produce accidents much more serious than would be the case if speeds are not so great and this will necessitate the constant maintenance of a high standard of line and surface.

Changes in Practice

These considerations immediately raise the question as to whether the present rather standardized type of track organization with which we are familiar will best meet the conditions in the future. Much more intensive supervision will be required and more and more maintenance operations will require methods that do not necessitate a reduction in the speed of trains. To some extent on multiple track lines this has been worked out by taking out of service for as long a period as possible during the working period, the stretch of track to be worked, and an increase of such practices will, undoubtedly, be necessary.

On many heavily-used lines it may be necessary to abandon completely what we now know as the small section gang. One factor in connection with this is the necessity to further mechanize many operations. To give this equipment a reasonable working period, it will be necessary to concentrate it in large gangs. The varied number of operations necessary to be performed by the small section gang almost precludes the possibility of an intensive use of machines. As a matter of fact, it is probable that the time has come when a thorough overhauling of the entire maintenance set-up as to organization should be made.

Much progress has been made in the introduction of machines in maintenance work. These machines have not only reduced the amount of heavy work, all of which was formerly done by man power, but they have reduced costs and in most cases do a better job. Power tampers, rail laying machines, mechanical adzers, spike pullers, power grinding and rail cutting tools are all examples of what has been done. Without a doubt, many other tools will be developed and a much wider equipment of maintenance forces will take place.

Tomorrow's traffic will necessitate much better average line and surface than we have heretofore thought necessary. Increased speeds will demand uniform elevation on curves, the amount of super-elevation being carefully determined to meet the operating conditions at each particular point. Easements will be universally used on all curves. What are now looked on as small variations in line and gage will not be permitted. A program of periodic out-of-face surfacing and lining main tracks will be necessary. In this way only can we secure those uniform conditions as to track support that are necessary to produce good riding track. They cannot be secured by depending only on periodic spot tamping.

While much has been said in the past as to the value of good drainage and the stabilization of the subgrade, it is believed that as yet this feature of track maintenance has not received the attention that it merits. It is clear that any stretch of track that requires current resurfacing at rather frequent intervals will, under future conditions, demand that a permanent solution be found that will eliminate such evident weakness in the subgrade. A recent survey on a 150-mile division developed some 50 locations where it was found that, due to unfavorable subgrade conditions, it was necessary to surface track sometimes as frequently as once each month. As the result of this survey, a program to correct these conditions has been initiated and, while it is not yet complete, real progress has been made so that these unstable locations will soon be eliminated. In many instances, it was found that corrections simply meant opening up ditches, tapping water pockets and, in a few cases, the removal from the roadbed of unsuitable soil and its replacement with better materials. Study showed that many of these locations were comparatively short and yet they were a constant source of expense and irritation and, in some instances, adversely affected the speed of trains.

In Its Investigation of Heavier Construction, The B. & L. E. Is Experimenting With Welded Track and GEO Fastenings

In order to assure satisfactory line and surface for higher speeds and, to some extent, extend the life of the materials in the track structure, standards must be raised as to the quality and quantity of ballast put under the tracks. It is axiomatic that from time to time ballast, when fouled, must be cleaned to the end that it may function as intended. In this particular part of the track structure it is believed that the future will demand that much more attention be given to this than we have been accustomed to give.

More Care of Ties

We fully appreciate the economy resulting from the use of treated ties and their installation will be continued to a greater extent in the future. By the expenditure of about 50 cents more per tie we can double its life. The economy of this practice is at once apparent. There are problems, however, in connection with the proper protection of a treated tie that remain to be solved and further study should be given to develop ways and means to accomplish this. Such problems start in the woods where the ties are produced and follow through the treating plant, proper care in handling, distribution and insertion in the track, and finally in continued protection as long as they are in service. The careful selection of ties, separated as to species, grade, etc., so that they may be placed in locations best suited to produce most economical results, deserves more detailed supervision. All too often we see first class ties put in unimportant side tracks and, on the other hand, we often see ties suitable only for side tracks placed in main lines. A further refinement will be to place ties of more nearly uniform size adjacent to each other. Such an arrangement will make for more uniform support.

It is generally recognized that all treated ties should be prebored and adzed before treatment. A diversity of rail sections and lack of uniform size of tie plates is frequently assigned as a reason for not following this practice. It is believed that, to some extent, this is more an excuse to save going to the extra work necessary to supervise proper distribution than it is a valid reason. In any event, a much larger percentage of treated ties should be prebored and adzed. The recent design of tie plates recommend by the Track committee of the American Railway Engineering Association calls for plates of greater area than generally used, increased thickness and double shoulders. This is certainly a step in the right direction. A more general recognition of the value of the double shoulder is bound to come in the near future. This is such a marked improvement over the single shoulder plate that all new plates purchased should be so designed.

Tie Plate Fastenings

More study, however, should be given to the method of attaching the plate to the tie. The destructive effect of movement of the plate on the tie is apparent—a more general use of the screw spike for the better holding of the plate has taken place in recent years. Many roads, however, rely on cut spikes for this purpose—many roads do not use either. It is of great importance that this problem be solved as soon as possible.

Further tests should be made of devices that take the place of the cut spike for attaching the rail to the plate. Certainly the last word has not been said in connection with either of these two elements of the track structure. In this connection, further tests should be made to cushion the tie plate on the tie or the rail on the tie plate, by the use of fibre or treated wood. A limited experience with some of these devices indicates that they improve the riding quality of the track and have some bearing on extending the life of the rail and tie.

Methods of retarding or preventing splitting must be developed. The "S" irons in common use are not effective —especially after they have been in service three or four years. There is a real need for more effective means to retard or prevent tie splitting. A solution of this problem will do much to further extend average tie life. It is likely that much can be accomplished by developing improved methods of seasoning. This is of such great importance that a research investigation into the causes and methods of retarding this destructive evil should be undertaken immediately. Inasmuch as the tie account includes the largest expenditure for material in the maintenance bracket, no effort should be spared to develop longer tie life.

In connection with turnouts, the rather recent development of curved switches is an important refinement over past practice. This in connection with improvements in the details of switch plates, braces and tie rods, will provide much more satisfactory conditions in this part of the track structure.

Improved Rail

Very definite progress has been made in the manufacture of rail but, as yet, some of the practices that have proven valuable have not been generally adopted. The end hardening of rail and the slow cooling process both indicate that they will further extend the life of rail and tend to reduce end batter. The building up of worn rail ends by the welding process provides a means of extending the life of the rail considerably before removal is necessary. Protection of track fastenings and tie plates from corrosion, lubrication of track joints, cross grinding of rail ends to prevent chipping, more frequent adjustment of expansion and resetting rail anchors, as may be necessary, are all practices that tend to extend rail life. Economy by the use of heavier sections than are generally installed, especially on heavy tonnage lines, is probably not fully appreciated. A recent study of a division where, some years ago, a change was made from 100-lb. A.R.A. Type B rail to 130-lb. section indicated a return on the added investment of 25 per cent and this study did not take into account many intangibles which accrued due to the use of the heavier section. It is believed that the future will demonstrate that a more general use of such sections as the 131-lb. and even larger sections, will produce marked economy in track maintenance. Comparing the stiffness of the 112-lb. and the 131-lb. R.E. sections, we find that by an increase in weight of 17 per cent we obtain an increase in stiffness of 36 per cent. It is believed that the most useful quality we buy when purchasing rail is stiffness. It is the cheapest way by which we can secure stability and this quality has an all-important effect on rail life. It is far cheaper to buy steel than to have to make up for a lack of stiffness by tamping ties. In the past some emphasis has been laid on the small amount of total metal in a rail that can be used up before replacement is necessary. As means are developed for extending the average life of rail this reasoning loses force and to this extent removes some objection to the use of the heavier sections. The recent improvements in the manufacture of rail and the more general use of methods to reduce rail batter have an important bearing on the economy resulting from the use of the heavier sections.

Track on the B. & L. E., Employing Double-Shoulder Tie Plates and Plate Lag Screws

Recent tests of welding rail into long lengths tend to show that this practice should be further explored under varied conditions, as it offers probable substantial savings, not only in the increased life of materials in the track structure and in less wear and tear on equipment, but also marked savings in the labor necessary to maintain line and surface. While experience is all too limited to make any positive statements, nevertheless the tests now in service prove beyond a doubt the practicability of such construction. Many of the difficulties that were anticipated have not been realized. As an illustration, it was feared that long lengths of rail would buckle under high temperatures. On one installation a mile long, which has been in service almost three years, records show a maximum rail temperature of 119 deg. F., and a minimum rail temperature of zero and no evidence of distress at any time. Accurate measurements at one end show a travel of the free end of only 9/32 in. during a change of rail temperature of 50 deg. Further installations should be made to determine the best method of welding, and intensive study should be given to the best method of attaching the rail to the tie plate. It is clear that two methods in use are adequate but it may well be that further study and use will develop designs that will be less expensive and still fully perform the service required.

The Wabash Crossing of the Missouri River at St. Charles, Mo.

B. and B. Men Study Problems At Annual Meeting

Intensive program, including eight reports and five addresses, a large attendance and lively discussion, characterized association's forty-fifth annual convention at Chicago

CARRYING out a crowded, yet well arranged program, designed to meet the routine and many special problems of railway bridge and building men, the American Railway Bridge and Building Association held one of its most successful conventions of recent years at the Hotel Stevens, Chicago, on October 18-20. At the five sessions of the meeting, all presided over by President C. Miles Burpee, research engineer, Delaware & Hudson, eight committee reports were presented covering a wide range of subjects, in addition to three addresses on timely subjects of particular interest to bridge and building men. One of these addresses was by R. A. Van Ness, bridge engineer, Atchison, Topeka & Santa Fe System, on Lessons to Be Learned from Recent Bridge Failures; another was by J. E. Long, superintendent of safety, Delaware & Hudson, on Safety in These Days of Reduced Forces; and the third was by L. P. Kimball, engineer of buildings, Baltimore & Ohio, who spoke on Current Trends in the Design of Railway Buildings.

Technical reports were presented on the following subjects: Meeting Today's Demands with Cranes and Pile Drivers; Recent Developments in Field Methods in the Construction of Timber Trestles; The Maintenance of Movable Bridges; Pipe Lines for Railway Water Service; The Maintenance of Cinder Pits; The Insulation of Railway Buildings; The Inspection and Preparation of Wood Surfaces for Painting, and The Possibilities and Limitations of the Acetylene Cutting Torch.

Special Features

Other features of the program included two motion pictures on Tuesday evening, showing "Heat and Its Control," presented by Johns-Manville, and the Erection of the Golden Gate Bridge, presented by the Bethlehem Steel Company; the annual luncheon on Wednesday, addressed by Samuel H. Cady, vice-president and general counsel of the Chicago & North Western, on What Is Ahead for the Railroads; the annual dinner on Wednesday night, and a trip through the Underwriters' Laboratory on Thursday afternoon, where members were given an opportunity to observe the work of this organization in the interest of safety and fire protection, and to witness several impressive tests of fire-prevention and fire-fighting equipment.

Lending support to the association, four committees of the American Railway Engineering Association and the Executive committee of the American Wood Preservers Association, held meetings in Chicago during the days of the convention and attended one or more of its sessions. The A.R.E.A. committees were those on Buildings; Wood Preservation; Water Service, Fire Protection and Sanitation; and Wood Bridges and Trestles.

Greetings

The convention was opened with an address by A. N. Williams, president of the Chicago & Western Indiana, and the Belt Railway Company of Chicago, and with greetings from the American Railway Engineering Association and the Roadmasters and Maintenance of Way Association. The former was represented by its president, F. E. Morrow, chief engineer of the Chicago & Western Indiana, and the Belt Railway Company of Chicago, while the greetings from the latter were conveyed in a letter from A. H. Peterson, president of the association and managing editor of the Railway Engineering and Maintenance Cyclopedia.

In his words of greetings, Mr. Morrow reviewed the efforts of man since early civilization to better his condition through more suitable housing and means of spanning streams, and then said, in part, as follows:

"These early developments in bridges and in building construction preceded the advent of the railroads, so that when the railroads came upon the scene, they were able to draw from the experience and developments of past ages in providing bridges and buildings so essential to their operations. It is true that the railways had to adapt the principles of earlier structures to their own particular needs, and that much development was necessary, and this is still proceeding. It is in this field of adaptation and development that your association works. It is a splendid and important field, and is worthy of the most painstaking effort on your part. It is a field of work in which all of you can take great pride. Evidence of the efficient work done in this field is present on every hand."

President Burpee's Address

In his address to the association at the opening session, President Burpee, in the light of the accomplishments of the association over the years, said, "It is evident that the foundations of this association were laid in the spirit of truth, unselfishness and mutual co-operation, the better to insure the advancements of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings and other structures." Continuing, he reviewed the activities of the association during the last year; commended the committees for their intensive activities; and spoke of the increasing problems of bridge and building men and of developments affecting their work. Concerning the value of the association to its members, he said, as follows:

"One of the first advantages lies in the eligibility to serve on investigating committees. A second is the opportunity which the association affords for meeting and making friends with other bridge and building maintenance men from many parts of America. Still another advantage is attendance at its annual meetings, with their reports of unquestioned educational merits, and the opportunity between sessions to discuss perplexing problems with other members whose practical experience may provide the solution of difficult problems. In addition, the publication of the official proceedings forms a permanent record of invaluable information for bridge and building men."

In conclusion, Mr. Burpee urged renewed interest on the part of members to the end that, in spite of any difficulties that may lie ahead, the association will move forward to greater service and usefulness to its members and to their railways.

The attendance of railway men at the convention was 165, a larger attendance than in 1937 and one of the largest during the depression years, and the secretary reported that 35 new members had been taken into the association during the year.

Officers Elected

In the election of officers at the final session, Armstrong Chinn, chief engineer, Alton, Chicago, was advanced to president, while F. H. Cramer, assistant bridge engineer, Chicago, Burlington & Quincy, Chicago; A. E. Bechtelheimer, assistant bridge engineer, Chicago & North Western, Chicago; H. M. Church, general supervisor bridges and buildings, Chesapeake & Ohio, Richmond, Va.; and R. E. Dove, assistant engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago, were elected first, second, third and fourth vice-presidents, respectively. C. A. Lichty was re-elected secretary-treasurer, and the following were elected directors: B. R. Meyers, assistant engineer, Chicago & North Western, Sioux City, Iowa, (re-elected); W. Walkden, bridge engineer, Canadian National Railways, Winnipeg, Man.; A. S. Krefting, assistant engineer, Soo Line, Minneapolis, Minn.; W. R. Ganser, master carpenter, Long Island, Jamaica, N.Y.; and F. H. Soothill, chief building estimator, Illinois Central, Chicago.

C. M. Burpee
President
As bridge and building supervisor on the D. & H. for six years, followed by three years as purchasing engineer and the last five years as research engineer, Mr. Burpee has had broad experience in maintenance work and materials.

Subjects for Next Year

The following eight subjects were selected for study by committees of the association during the next year:

The Maintenance of Shop and Engine-House Roofs; Deteriorated Concrete—Causes, Detection and Methods of Repair; Present-Day Methods of Safeguarding Bridge Substructures; Bridge Painting Problems Resulting from Deferred Maintenance; Pumping Equipment to Meet Today's Requirements; Preframing Treated Timber for Replacement Purposes; Glazing Maintenance in Shops and Engine Houses; and Revision of Bridge Maintenance Methods to Eliminate Slow Orders.

Chicago was selected as the convention city for 1939.

B. & B. Supply Men Elect Officers

Deviating from its usual practice because of the generally unfavorable business conditions, the Bridge and Building Supply Men's Association did not hold an exhibit in conjunction with the convention, but, at its annual business meeting, held on Thursday, all of its present officers and members of its Executive committee were re-elected, with one exception. The present officers are, therefore, President, K. T. Batchelder, manager railroad sales, Insulite Company, Chicago; vice-president, Earl A. Mann, director of sales, Standard Brake Shoe & Foundry Company, Pine Bluff, Ark.; treasurer, Harry A. Wolfe, The Lehon Company, Chicago; secretary, W. S. Carlisle, representative, National Lead Company, Chicago; honorary director, L. F. Flanagan, representative, Detroit Graphite Co., Chicago.

Members of Executive committee —G. W. Anderson, Patterson-Sargent Company, Chicago; A. J. Filkins, general manager, Paul Dickinson, Inc., Chicago; G. W. Morrow, sales engineer, Ingersoll-Rand Company, Chicago; C. C. Rausch, assistant to sales manager, Dearborn Chemical Company, Chicago; and E. E. Thulin, district manager, Duff-Norton Manufacturing Company, Chicago. The one new member elected to the Executive

F. H. Masters
First Vice-President

Armstrong Chinn
Second Vice-President

C. A. J. Richards
Third Vice-President

F. H. Cramer
Fourth Vice-President

C. A. Lichty
Secretary-Treasurer

committee was C. E. Ward, railroad sales manager, U. S. Wind Engine and Pump Company, Batavia, Illinois, who succeeded Guy C. Mills, Zitterell-Mills Company, Webster City, Iowa.

All of the reports and addresses presented before the convention, with the exception of the addresses by R. A. Van Ness and L. P. Kimball, which will be published in subsequent issues, are presented, with discussions from the floor, in the following pages.

Bridge and Building Association

Officers 1937-38

C. M. Burpee, President, research engineer, D. & H., Albany, N.Y.

F. H. Masters, First Vice-President, assistant chief engineer, E.J. & E., Joliet, Ill.

Armstrong Chinn, Second Vice-President, chief engineer, Alton, Chicago.

C. A. J. Richards, Third Vice-President, master carpenter, Penna., Chicago.

F. H. Cramer, Fourth Vice-President, assistant bridge engineer, C. B. & Q., Chicago.

C. A. Lichty, Sec'y-Treas., Chicago.

Directors

E. C. Neville, Past President, bridge and building master, C.N.R., Toronto, Ont.

(Terms Expire October, 1938)

B. R. Meyers, assistant engineer, C. & N.W., Sioux City, Ia.

G. S. Crites, division engineer, B. & O., Punxsutawney, Pa.

R. E. Dove, assistant engineer, C.M. St. P. & P., Chicago.

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What's Ahead for Our Railroads?

By SAMUEL H. CADY

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THE earnings record of the railroads of this country for the first six months of 1938 indicate that it is a dying industry. The railroads earned only about one-third of the interest charges accruing during that period. This statement is the more arresting when we realize that the bonded indebtedness of our Class I railroads is only about 40 per cent of the investment. All this talk about the railroads being over-capitalized is sheer folly.

What Has Happened?

What has happened to the railroads? Railroads which were prosperous for 60 or 70 years have suddenly become impoverished, some of them being able to pay but little of their interest and others paying it only by the greatest effort and at the sacrifice of proper maintenance of way and structures and equipment. Many things have happened to the railroads, and I will review a few of them.

The railroads have been a political football for many years; politicians have vied with each other in damning them; laws were passed by the federal government and by the states regulating them; railroad management now has little control over many subjects which are purely managerial. For example, a railroad cannot change its signals without an order of the Interstate Commerce Commission. In most states, stations cannot be closed without the approval of the state commission. Rates and services are prescribed: full-crew laws, and hours-of-service laws confront railroad management at every turn. These are typical illustrations of regulations that hamstring the railroads. All of this regulation is based upon the original theory that the railroads have a monopoly of transportation.

Samuel H. Cady

The railroads made contracts with organized railroad labor under conditions entirely different from those of today. They have been unable to change these contracts. At the time these contracts were made, no one could have imagined that an engineer would receive one and a third days' pay for operating a train for 2 hr. and 5 min., or that under any circumstances would an engineer receive a full day's pay for 1 hr. and 16 min. of work. Besides, many of the deci-

sions of the National Railroad Adjustment Board, interpreting contracts between the railroads and their employes, have greatly increased operating costs.

Taxing bodies have usually been liberal with railroad money. In many states, railroads have at times been assessed twice the value of their properties when measured by any reasonable standard of values. Often they have had to litigate their assessments to obtain justice. The recent Railroad Retirement act and Social Security act added substantially to the tax items of railroad operating expenses.

The most important factor in producing the present plight of the railroads has been competition, much of which has been subsidized. In addition to these conditions, the railroads have been kept from doing many things that would have helped them meet the competitive situation. They are not permitted to use the Panama canal, either directly or indirectly; nor are they permitted to engage in water transportation except upon the order of the Interstate Commerce Commission. The Transportation act of 1920, as interpreted, practically blocks consolidations where they would be most advantageous, by providing that competition shall be maintained as fully as possible. The railroads are not permitted to engage in the trucking business where it would help them most.

What Is Ahead?

I now come to the question propounded in my subject, "What's Ahead for the Railroads?"

One thing is certain. The conditions under which they now operate cannot continue. Have the railroads outlived their usefulness and will they go the way of the stage coach? Absolutely and emphatically, no! Transportation by railroad is the most economical for large-scale movements which has yet been devised. Comparative studies made recently by the National Resources Board develops the fact that it takes 50 man-hours to move 1,000 tons of freight one mile with a 5-ton truck, over a concrete road as against six man-hours to move 1,000 tons of freight the same distance on Class I railroads. It appears, therefore, that it is much cheaper to make mass movements of freight by rail than by truck. When time is a consideration, transportation by inland waterways is not efficient.

The railroads have a permanent place in the transportation of this country unless transportation methods change substantially from what they are at present. Their place is assured as a means of national defense. This is a country of magnificent distances; speed in transportation is of great importance in time of war. Little has been said in public about the necessity of our railroads in times of war, because as a nation we refuse to face realities. We refuse to recognize the fact that, with the possible exception of Canada, the United States has not a national friend on the globe which would be ready to help defend its political integrity, except for a consideration. What a sorry sight would be created if we found it necessary to move hurriedly a couple of million troops and their armanents and supplies from New York to Los Angeles by trucks over politically built highway systems.

Government Ownership

Unless something is done to remove the handicaps under which the railroads operate, it will be necessary for the government to take them over. That would be a national calamity. Government ownership would constitute a debasing influence in the political life of our country; it would offer a constant temptation to an administration to make concessions to employees, states, cities and communities as bait for political preferment. Thus a party in power could increase the likelihood of self-perpetuation.

Government ownership of railroads would be followed progressively and quickly by government ownership of the coal mines, steel mills and lumber mills, required for supplying the railroads. This would be a long step toward the socialization of all industry. Government ownership would bog down the efficiency of the railroads, and the political strength of railroad employees would mean concessions resulting in increased operating expenses. Furthermore, the demands for unjustified extensions of lines, new station buildings and non-self-supporting services, made by politically powerful interests and granted as a matter of political expediency, would still further increase investment and operating expenses; demands made by the farmers for reduced rates on agricultural products, and similar demands by other vote-controlling blocs, would inevitably reduce income and a deficit would result. Thus an additional burden would be put on the taxpayers to make up the deficit.

What Should Be Done?

What, then, should be done? There are two principal things.

First: The restraint against consolidation of railroads should be removed. Consolidations should be encouraged rather than discouraged. Where railroads are strongly competitive they should be required to consolidate in order that wasteful duplication of facilities and service should be eliminated. Vast sums could be saved annually thereby. The present policy of the government in requiring competition in railroad service is scientifically uneconomical and destructive to the railroads. Incidentally, the public should insist on a discontinuance of all make-work legislation, and on revision of the working rules so that a reasonable amount of work shall be done by every employee in consideration for reasonable wages paid.

Second: The whole policy of the government in fostering water and truck transportation at the expense of the railroads should be changed, or else the government should do the same for railroad transportation as it does for inland waterway transportation, namely, foot the bills for maintaining the rights of way. What would this cost? Probably about $750,000,000 a year. This might seem a tremendous sum to pay annually as a subsidy to the railroads, but it is only about half as much as the governments (exclusive of cities) are expending annually for highways. As railroads are consolidated and unnecessary duplicate tracks are abandoned or declassed, this amount would be reduced.

It will be said that this suggestion is preposterous. What is preposterous about a suggestion that the government give equal treatment to all competing forms of transportation, especially when the suggestion applies to a national defense necessity? Besides, the suggestion does not entail nearly the expense which would follow government ownership.

Employees Must Help Solve the Railways' Problems

By A. N. WILLIAMS

President, Chicago and Western Indiana and The Belt Railway Company of Chicago

I LIKE to think of these meetings as staff meetings in which you go over your problems, to the end that each one understands his work better and gets a clearer realization of the important part that each necessarily has in the successful operation of his department and of his railroad. At this time, it is incumbent upon supervisory officers of the bridge and building department to take an increased responsibility in the selection and training of employees for future positions. The average bridge foremanship today requires a higher type of man than was necessary even 15 years ago. With higher speeds and greater refinement of design and maintenance, increased supervision is required down through the foreman, and it is the big job of the bridge and building department to train and educate a class of foreman differing from those you and I were accustomed to when we were younger.

Need Promising Young Men

You should ever be alert to pick up promising young men in your territories and get them interested in railroad service. Get them to work as laborers and then spend some time watching them and developing them through to foremen, to the end that when it becomes necessary to replace foremen you have your own men ready and trained to fill these positions. Nothing illustrates a supervisor's ability more than to be supplied continuously with material coming along, from which foremen and supervisors can be made, and to have ready and at hand such material when the necessity arises. Each man's territory is a special and particular problem having different physical conditions, different labor conditions and different political conditions.

The work of the bridge and building department is a fight of man against the elements and your organizations are tested in many emergencies. American bridge and building officers have always measured up to their responsibilities.

Bridge and building officers should be on the alert to call the attention of their division and other superior officers to changes in their territory. These changes cover business changes, new industries, new materials, new sources of supply for old materials, new potential passengers, and other factors which directly affect our well-being and the well-being of the industries that support us.

A. N. Williams

There is nothing more important in the supervision of any line of activity than the budgeting, planning and co-ordinating of all of one's activities. I know that all of you are giving this matter your special attention. I realize that it has been quite difficult for many of you to plan during the last seven or eight years, while expenditures have been largely reduced, making it necessary for you to spread your appropriations pretty thin at some points. With decreased budget allowances, each of you is faced with the problem of making the dollar go as far as possible. The size of the budgets will not allow for any mistakes, such as allowing work which should be done in the summer months to drag over to the winter.

Employees Must Know Facts

You are all familiar with the very serious situation in which the railroads find themselves today. I believe it is the duty of each of us railroad employees, especially those in supervisory positions, to be entirely conversant with the present situation of the American railroads and the factors involved. Each one of us should make every effort in our daily contacts to bring the true picture of the railroad situation before the public.

For the last eight years the railway industry has had particularly hard sledding. Our income has been reduced and our expenses have increased heavily, and despite all of the work and money that we have put into improved facilities to increase operating efficiency, we have not been able to overcome the obstacles over which we have no control. Our railroad troubles have not resulted in any large and general measure from conditions within the industry itself. Competition has taken 20 per cent of the business away from the railroads, and has removed an equal or greater amount of labor from the railroads. Unless railroad transportation can compete in cost with other forms of transportation, the railroads will lose the business and railroad employees will lose their jobs.

Employee Welfare

You supervisory officers know that railroad management is interested in its employees. We try to understand their problems; we try to give them good, clean, healthful and safe working conditions. No industry can claim a better record than the railroad industry in its desire to pay its employees a fair wage so far as it is within its power to do so. I can assure you that management would rather increase than decrease the wages of its employees, if revenues and earnings would permit.

The railways have always permitted the participation of the employees in prosperity by constantly increasing wages. The employees, in turn, should recognize, for their own security, that those who enjoy more in periods of prosperity must meet the situation by getting less in periods of depression.

The probable effect of excessive taxation of both industry and the worker is a matter of very serious concern. This matter should have the careful thought of all employees and of their bargaining representatives. Further increases in taxes mean

higher costs to the worker in the payment of "indirect taxes"; they also mean less security of employment for railroad workers.

Beginning in 1933, governmental policies with respect to agriculture and industry have been to increase wages and the sale price of the products of agriculture and industry. These policies have increased the cost of the materials which the railroad must buy. In addition social security and the railroad pension taxes have added to their burdens. All this means just that much less money available for the payment of wages.

We must not lose sight of the fact that the railroads are not free to increase the price of their product, transportation, to ease the burden of the increased cost of operation, the same as other industries. We must remember also that a price cannot be charged for a service or product above that which the public can pay.

Employees Can Help

If railway workers made a real effort to increase the business of their companies and to improve their net earnings, their companies would then be able to pay higher wages with no danger to their financial positions or that of their workers. There is no question but what there is a dire need for more enlightenment of our employees concerning our political and economic problems. This can be accomplished only by a spirit of trust and confidence between the workers and management, and by placing before the workers, in plain, simple language, the facts involving our particular problems. In other words, both worker and management must realize that the prosperity of one is dependent upon the prosperity of the other.

Railroads Want Equality

The railroads are controlled and restricted on a 50-year-old theory that they exercise a monopoly—yet they are called upon today to compete for business against every other form of transportation. What railroad men want is simply equality and the same freedom of judgment and initiative in running their business that are enjoyed by every successful business in America.

The American railroads, under private ownership, have kept pace with the progress of our country. Today, they provide a service which has no equal at any period in railroad history in this country or the entire world. The American people pay slightly less than one cent to transport a ton of freight one mile,—less than it costs to mail a postcard; they are provided dependable freight service on passenger train schedules; they are taking advantage of all the latest achievements in transportation equipment; and their safety in travel is assured by an almost faultless record in safe operation. And while furnishing this service, the railroads are paying their own expenses, without government assistance.

To relieve the crisis confronting the railways is beyond the power of the railways themselves because its causes are beyond their reach. It is a job for public policy, for economic statesmanship, for fair dealing. It is a job that cannot be done unless we all are willing to renounce the idea of getting something for nothing in the way of transportation, at the expense of the vague and unidentified "other fellow,"—the taxpayer, who, most disconcertingly, turns out to be all of us.

The Maintenance of Movable Bridges

Report of Committee

THE responsibility for the maintenance of movable bridges and their appurtenances rests with the engineering department, and primarily with the bridge engineer. Reports of incorrect operating conditions or of the failure of any parts to function properly should be forwarded to the bridge engineer by the engineer or supervisor directly in charge of the bridge. Matters requiring immediate attention should be reported to him directly from the field so that he can initiate appropriate action to restore normal operation as quickly as possible.

Operators Must Be Informed

It is imperative that the operating personnel be fully informed and thoroughly familiar with the functioning of the various devices and mechanisms provided to insure safe and efficient operation of the bridge. Their correct understanding of and familiarity with the uses of these various devices and mechanisms should be checked frequently under actual operating conditions. The operating personnel should be made to realize that the electrical equipment, for example, of the average movable bridge includes much delicate and relatively complicated apparatus that should be tested frequently. This equipment requires exact adjustment, and they should know from their experience in the handling of the bridge when adjustments are necessary.

A. E. Bechtelheimer
Chairman

Periodic Tests Required

Where bridges are operated by gasoline engines, whether equipped with the old "make and break" or a self-starter, the units should be tested at definite intervals to keep them in condition for service. Where they are used infrequently, engines should be operated at regular intervals to keep the batteries charged. Where small battery-charging units are available, the intervals between tests of the engines may be increased.

The operating personnel should be made to understand that the operating machinery will not serve as a brake to stop over-travel of the movable span. Unless this is stressed frequently and forcefully, the operators are liable to adopt the practice of reversing the machinery to stop the span swing and avoid over-travel, causing excessive wear and possibly damage. Invari-

ably, tests of the operations of movable bridges are made under the most favorable conditions, that is, in daylight and fair weather. Unless these tests are also made to cover the unusual conditions, complete protection is not assured. The correct use of the hand brake, the electrical brake and the emergency brake should be fully understood. This requires that all tests should be carried to the point where the emergency brake functions. Tests of the air buffers and all other emergency devices should be conducted in the same manner.

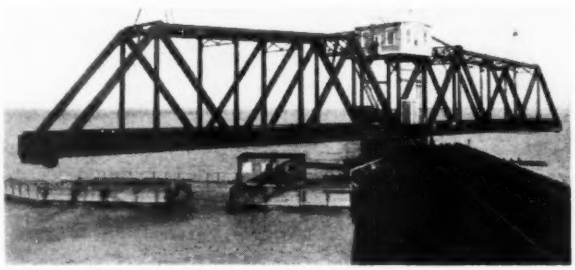
Frequent and complete tests of all of the facilities and protective devices on each movable bridge is good assurance against serious trouble. The frequency of inspections and service tests must be suited to the duty and age of the bridge. Such inspections and tests are primarily a mechanic's job or the work of a man having mechanical sense. The organization of the operating personnel must be such that supervisory officers can get at the cause of failures and effectively set up ways to eliminate them.

Substructures

Problems relating to the maintenance of the substructures of movable bridges will be given only general consideration in this report. It is self-evident that the substructures of movable bridges must be substantial and adequate to meet fully the requirements imposed upon them, and that they must be maintained in good condition at all times. Bearing areas supporting the superstructure must be true to surface and to grade, and must be capable of withstanding the shock loads that come upon them without undue displacement. The materials used in making repairs to substructures must be of a kind that will act without a tendency to flow, break up, be abraded by the action of the moving bridge part, or be affected adversely by the natural elements or by the loads which pass over the bridge.

One railroad makes the following report of repair work done on an old swing bridge substructure to meet the more exacting requirements of present-day structures. The work was done in 1937 on a 230-ft., two-track through riveted truss swing bridge which carries a large volume of rail traffic, consisting of switching movements and high-speed passenger trains. The bridge was built in 1898 and the machinery was remodeled in 1908. Crowding of the masonry abutments had continued for a long time, probably starting soon after the bridge was built. Abutment anchorage had been installed years ago, but it was not very effective. The backwalls had been chipped to clear the ends of the movable span as this movement continued. The end bearings and latch castings had been moved a number of times until they were partly off the bridge seats and on masonry inadequate to carry the loads.

The work done in 1937 consisted of replacing the bridge seats and backwalls with reinforced concrete blocks, and the installation of more substantial anchorage for the abutments. The anchorage at each abutment consisted of rods extending through the new bridge seat blocks, and back through the fill to steel sheet piling and treated timber blocking located about 45 ft. back of the abutment. After the bridge seats and the anchorage work were completed, additional new concrete was poured in the backwalls.



Proper Lubrication Is of Vital Importance for the Efficient Operation of Movable Bridges

Lubrication

The operating machinery, bearings and all moving parts of movable bridges require careful lubrication to insure ease of operation and minimum wear of surfaces in contact. Fast moving parts and bearings under heavy loads should be given special attention. The importance of lubrication demands that the responsibility for this work be definitely fixed. It is necessary that supervising forces see to it that the work is done thoroughly. A greasing chart should be posted for the guidance of oilers at bridges where many parts require lubrication. It is good practice to make a thorough check of the oiler's work not less than twice a year, preferably in the spring and in the fall. This can be done best by a mechanic specifically assigned to inspect and make minor repairs and adjustments to the operating machinery. Costly repair work can often be avoided by close attention to the lubrication of the operating machinery.

It is essential that good grades of lubricants be used. Proper care in the selection of lubricants will make it unnecessary in many cases to change the grades of the lubricants for summer and winter lubrication. In one instance, it was reported that a grease was being used that would pack and harden in the pressure cups. When this was investigated, it proved a simple matter to select a grade that would lubricate the year around. A careful check of each lubricating problem should be made to determine the kind of lubricant to be used.

On large trunion bearings the grease grooves are relatively long. In the early fall, these grooves should be rodded and cleaned thoroughly, a light oil forced into the grooves, and the span then operated a few times to distribute the oil. Immediately following this, the grooves should be filled with grease, using a grease gun, and then the pressure cups should be put back in place. If the cups are then refilled as required, good lubrication will be assured. This procedure is more important than a change in the grade of the lubricant.

On swing bridges, close attention should be given to the cleaning and oiling of the center bearings. The center should be drained periodically, washed and refilled with new oil. The washing should be done with a light lubricating oil, diluted with kerosene; otherwise the oil film will be washed out and the surfaces of the discs will run dry before the new oil works in and becomes effective. This will cause a bad situation, as the dry surfaces will stick and cause a noise.

Liberal lubrication of end lift wedges is also necessary.* Lack of sufficient lubrication is sure to result in failure of the power unit to drive the wedges home.

Failure of a bearing to be lubricated properly may not always be caused by a faulty lubricant or by lack of attention on the part of the oiler. Bearings under heavy loads may be distorted if not supported uniformly over the entire surface, thus putting such abnormally high pressures on some areas of the bearing that the lubricant is forced to adjacent areas where pressures are not so great. Such a situation is sure to cause trouble, and, while difficult to correct, it is possible to improve the situation. The edges of grease grooves should be rounded, otherwise the sharp edges

will cut the grease film from the shaft instead of spreading the grease.

Bearings under heavy loads can be equipped with special fittings, permitting the greasing to be done with a high-pressure grease gun. In one case reported, a heavy bascule bridge was equipped with 90 fittings, through which grease is forced every 24 hours. The old grease is forced out through pet cocks located at suitable points.

Care of Machinery

Bolts holding bearings to the structural supports should be kept tightened. Suitable reinforcement should be provided for bearings which cannot be held against movement, even though bolts are tight. This can be accomplished by bolting, riveting or welding short angles or bars around the bearings to form shoulders to resist the thrust from the bearings.

Shafting should be watched to see that looseness does not develop in the bearings. Ordinarily, liners can be removed and the caps adjusted to take out looseness. Metal liners are better than fibre liners in most cases, because more accurate adjustments are possible. Where unusual looseness exists, it may be necessary to rebabbitt the bearings or to install new parts.

Bearings and shafting should be checked for alinement. Their behavior should be studied under operating conditions to insure that load conditions do not produce changes in alinement which, if not corrected, will cause unnecessary wear. Likewise, the action of machinery supports should be studied under actual operating conditions to see that they do not bend or warp, resulting in misalinement under load. This is especially important in the case of new bridges where it is essential that a thorough check be made of every machinery part to see that it is acting properly, and equally important, to make final adjustments of the bearings, shaft couplings, clutches, limit switches, worms, equalizers, and the meshing and alinement of gears.

Gears should be watched to see that they are tight on the shafts. Loose gears cause wear of the keys and the key ways, necessitating fitting offset keys or recutting key ways, or putting in larger keys. Information received concerning work done by one road states that loose gears were arc-welded to the shafts to make them secure. Where this is done, it is feasible to take the whole assembly to a machine shop for removing the weld beads in case it is necessary to renew the gears or shafts.

It is imperative that spare machinery parts be available at each bridge to replace those parts that cannot be obtained on short notice; also spare parts for anticipated renewals. Frequently, defective parts can be repaired for temporary or even regular use by welding. The broken teeth of gears can be built up; broken shafting can be butt-welded; and shafts worn in bearings can be built up and then turned to original dimension. It is oftentimes possible to obtain gears from standard stocks, or they can be cut from standard blanks on short notice. Spur gears have been flame-cut from structural slabs and used without finishing. It is well to remember also that the "old blacksmith" is still on the job and can help out in many ways.

It is often necessary to remove a succession of gears and shafts to get to a gear which has become loose and is working on the shaft, or is otherwise defective. In some instances, it will be possible to replace such a gear with a split gear after destroying the old gear to get it out of the way. This procedure makes it possible to avoid removing a lot of machinery to tighten or replace the old gear.

The adjustment of electrical brakes on motor shafts, of limit switches on wedge drives and on rail lifts, and of emergency and hand brakes should be watched closely in order to keep these units in the best of condition.

Auxiliary Power

The auxiliary or stand-by power units should be maintained at maximum efficiency at all times. The operation of these units should be checked at prescribed intervals to make certain that they will be available when needed, and also to insure that the operating personnel will be familiar at all times with the use of these facilities.

In a test of an air motor at an important bridge, water resulting from air condensation froze in the motor. The installation of a device to introduce alcohol into the air line at the motor cleared up the trouble.

In a test of the hand-power mechanism on a very important bridge, it was found that the capstan and capstan shafts had rusted in the bearings and could not be used until several hours had been spent putting them in shape. In another case, it developed that the rack pinion had moved out of mesh with the rack. As a result, the hand-power unit could not be used until this condition was remedied. In still another case, it was found that the clutch that put the hand-power machinery in mesh with the turning machinery could not be used without being held in place by timber blocking. A thorough test of a gasoline auxiliary power unit at another bridge developed the fact that the adjustment of the control mechanism was such that two men would be required to operate the bridge where only one was ordinarily available. Proper adjustment of the control mechanism remedied this condition.

It seems fair to state that the auxiliary power units at movable bridges require more thorough inspection by the supervisory forces than do the primary power units, because they are more likely to be overlooked.

Swing Spans

There does not seem to be any reason for differentiating between center-bearing and rim-bearing types of swing bridges, or between the various types of end lift and end rail mechanisms, since the maintenance problems appear to be very much the same. There is a great deal of similarity in the defects which occur in each of these types.

It is essential that the track and rack sections be watched closely. Openings at the joints of the rack sections indicate that movements of these parts has occurred, resulting in wear and loosening of the bolts anchoring them to the track sections. This condition may be the result of the stretching or loosening of the bolts in the anchorage of the track, which causes loosening of the bolts of the track sections, permitting these sections to move, with the result that eventually the joints between the sections will be open. This can be corrected by tightening the anchor bolts of the track sections and cleaning and refitting the rack sections. It may be necessary to ream the holes in the rack sections and to substitute larger bolts. In cases where this will not correct the condition, thin strips of copper may be inserted in the openings before the final tightening of the rack bolts. Sheared or otherwise defective tap bolts in the tread sections should be replaced with tight-fit bolts. To do this, requires skilled workmanship.

Uneven wear of the rollers, caused generally by the center pier being out of level, should be corrected by removing the rollers and refinishing them to true conical surfaces, with the apex at the center of the ring. The area under the turntable track on the center pier should be bush-hammered to a true level surface. Shims should be placed under the track sections and between the upper tread sections and the drum flange to keep the spider, radial rods and

other parts in the same relative positions as though the rollers were full size.

Failure of some of the rollers to take bearing throughout the arc of the swing necessitates adjustment in their position on the radial rods. This change may result in causing the rollers to creep. Where power conductors, trolley and collectors are attached to the radial rods, creeping of the rollers creates a nuisance; otherwise, the action is of little consequence. The overhead collector arrangement, with towers at the ends of the center pier protection for carrying signal and power cables, is more satisfactory and more easily maintained than bringing power to the operator's house from the center pier, up through the turntable machinery.

Failure of a span to revolve on its true pivot throughout the arc of swing because of too much clearance between the discs and the walls of the center casting can be corrected by providing a guard ring and ring filler to center the top casting accurately in the chamber of the center casting.

Rack pinion shafts loose in bearings, improper mesh between rack pinion and rack, shrouded rack pinions riding racks, and rack pinions loose on the shafts can be corrected by careful workmanship, proper attention, and careful adjustment of the moving parts.

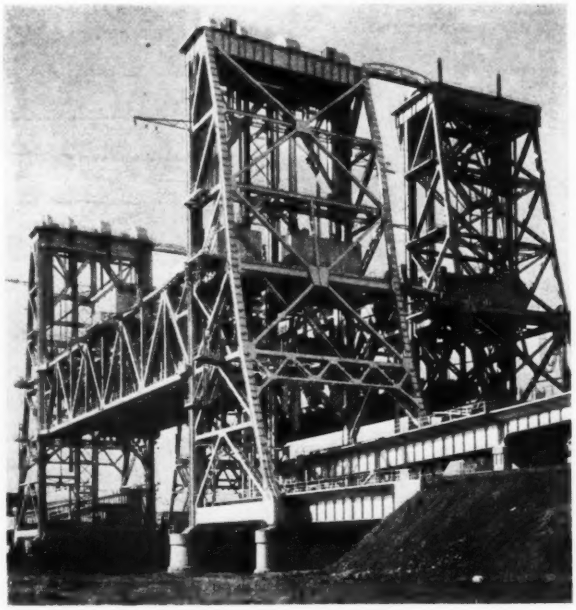
Improper design or unforeseen operating conditions often make it necessary to reinforce machinery struts, rack pinion bearing supports, and other structural details to which the turning machinery is attached. Failure to keep machinery in proper adjustment will necessitate extensive repairs, and the renewal and strengthening of supports, including the reaming of holes to permit the use of larger bolts at points where the machinery is attached to the supporting members. Broken rack pinion shafts and machinery shafts generally indicate poor alinement or adjustment in the bearings, and call for the correction of the cause of failure and the replacement of defective parts with parts of improved design or of a better grade of material.

The adjustment of the end-lift mechanism should be such that the bearings will not lift clear at one end when the opposite end of the span is loaded. This is especially important where end-lift wedges are used. The jar and vibration of traffic cause movement of the wedge arms, and the cranks are forced off center. Then when the wedges come down to bearing, they move out of position by backing up the machinery, leaving the ends of the span without firm support, constituting a very dangerous condition. Where signal locking devices are connected to the wedge mechanism, any movement of the wedges under traffic results in damage to these devices, making repairs necessary before they can be made to function properly. This condition can be corrected by the installation of brakes on the end-lift power units, or vertical locking can be provided at the head of each end-lift wedge.

The use of brakes, stop blocks or other devices to control the movement of end-lift and rail-lift machinery is necessary to insure against over-travel of this machinery and consequent damage to moving parts. The use of these devices makes it possible to maintain close adjustments of the mechanisms which they control, and permits their more rapid operation.

Smooth, safe train operation over movable bridges at moderate speeds can be had only when the end rails of such bridges are properly maintained and kept in good adjustment. Positive anchorage of the running rails on movable bridges is desirable. The use of rail anti-creepers or other anchoring devices at the ends of the approaches to a movable bridge is necessary to keep the track rails from creeping toward the bridge and fouling the rails on the movable span, or to prevent movement in the opposite direction, with consequent battering of the rail ends at the open joints produced.

The end rails must be kept in good surface by careful adjustment of the rail plates to insure against breakage and excessive wear of the rails. The movable rails must be supported uniformly throughout their entire length; otherwise, they will deflect at points of poor support and excessive up and down movement of the rail will occur. The ties should be uniform in size and spaced evenly. The rail plates at the heels of lift rails should be given special attention to see that all bolts are kept tight and that the joints are shimmed whenever looseness is noticed. Bad riding joints are greatly improved by moving the rail anchorage from points adjacent to the end timbers to points near the centers of the rails. In a case noted recently, a part of this anchorage consisted of wide plates which extended over three ties. These plates did not cut into the ties as deeply as the tie plates back of them, which resulted in the ends of the rails being lifted as each car truck approached the anchorage, and then being slapped down as the track passed over the joint.



The Two- and Three-Track Lift Bridges of the Pennsylvania Over the Passaic River, at Newark, N.J., Involve Many Unusual Features

Bascule Spans

The maintenance problems in connection with bascule bridges are not essentially different from those for swing bridges. Moving parts require more careful adjustment; brakes, limit switches and other control devices must be timed accurately and kept in first-class condition.

The maintenance problems are simplified if the structural supports for the bearings of the operating shafts and gears and for the other machinery bearings are substantially built to withstand the shocks and jars in-

herent in the operation of this type of bridge. The design of adequate reinforcement for these supports is limited by the practicability of carrying out the field work because of their inaccessibility. By way of illustration, mention is made of such typical repairs as the anchorage of the machinery girders to the tower girders; the reinforcement of the machinery supports on top of the hanger posts; repairs to the tower posts and trunnion hangers at points where the operating shaft bearnings are attached; the alinement of the operating strut guide; and the adjustment of the trunnion bearings.

The rack sections in the operating struts should be watched for signs of loosening and for broken teeth. A defective tooth in a rack section adjacent to the operating pinion gear can be corrected temporarily by interchanging the defective section with a section at the trunnion end of the strut.

Pneumatic emergency brakes are generally used on heavy bascule bridges for the control of the moving span when operating under unusual conditions. These brakes are important adjuncts to the operating machinery and require unusual attention to keep them in working order.

A pneumatic buffer is an essential feature of the heavier bascule spans and should be kept in operating condition at all times. There are definite limits to the effectiveness of air buffers, and they afford no assurance against damage to the bridge resulting from careless operation. End locks should be maintained in good condition, especially on double-leaf spans.

It is necessary to give close attention to the counterbalancing of bascule bridges. There are limitations to the additional weight that can be added to bascule bridges, as for the reinforcement of structural parts or increased weights of track and other materials. Maintenance of the counterweight unit is important.

Unbalanced counterweight loads increase the hazards when bridges are being operated, and also cause excessive wear on operating machinery which may result in increased power costs.

Vertical Lift Bridges

The maintenance problems on lift bridges are similar in many respects to those on swing and bascule bridges. The repair and adjustment of the lift machinery require the same care as for machinery on other types of movable bridges, although this type of bridge permits the assembly of the machinery in a very compact unit, with fewer parts to be looked after.

The operating cables should be inspected closely for wear of the wire strands. The liberal use of good cable dressing will protect the cables from deterioration and wear. The counterweight sheaves, operating drums, and guide sheaves should be checked carefully for alinement to insure minimum wear on the operating cables. Where the counterweight cables are separate from the up-and-down haul cables, all of them should be watched closely and adjusted as necessary to keep the bridge correctly balanced and centered in the guides on the tower posts to insure operation without unnecessary friction and wear in the guides and the proper seating of the span on its bearings.

It should scarcely be necessary to caution against the method used a few years ago of forcing the full seating of a lift bridge when one end of the bridge cannot be seated by the operator.

Bridge End Rail Joints

Devices for bridging the rail gaps at the ends of movable bridges vary in design to accommodate the particular class of traffic over the bridge. Frequently they must be maintained for speeds as high as 70 miles an hour. In most cases the rails extend beyond the ends of the movable spans and must be firmly supported to minimize movement up and down and to eliminate the hammer blow of the moving wheels as each wheel passes over the joint.

The following are some of the more common types of joints:

(A) Rails with square ends, with open gaps between them.

(B) Rails with mitered ends which overlap and form a continuous wheel bearing over the joint.

(C) Rails, one of which is mitered and the other bent outward so the web will be parallel with the mitered rail. The head and base on the bent end are cut off flush with the web. The two ends overlap.

(D) Rails with their ends bent and with the head and base of each cut flush, with its web on the side adjacent to the other rail so the two rails will overlap. The inner projecting portion of the head of one rail is planed to the gage line.

(E) Rails with square ends and with open gaps bridged by a bar or tongue sliding in contact with the webs and heads of the rails and fixed guides on the outer sides of the rails. The gaps are at the ends of the movable span, and the ends of both rails are rigidly anchored.

(F) Rails with the ends mitered to overlap a small amount, the gap extending beyond the ends of the movable span and rail locks being bolted to the ends of the rails of the movable span and straddling the ends of the fixed rails. The inside lock is formed with a flangeway, and the outside lock bridges the gap.

Types A, B, C. and D are applicable particularly to swing and lift bridges; Type E to all movable bridges; and Type F to bascule bridges only.

Types A, B, C, and D present many maintenance problems on swing bridges because the shore ends must be lifted to clear the fixed rails when the bridge is opened; hence, it is evident, these rails cannot be fastened down rigidly through any part of their lengths.

Types E and F present two major maintenance problems. The first consists of holding the rail locks and the slide bars in position against the rails, and the second consists of maintaining the correct surface of these devices with respect to the running rails so that they will actually bridge the gaps and afford smooth riding over the joints. These devices should be maintained about 1/8 in. higher than the rails at the gap, particularly if train speeds are at all high. They should be slightly below the rails at the ends and rounded from the ends to the center. The top surface should be beveled at right angles to the rail to the taper of car wheels, to afford increased wheel tread bearing surface.

The time limitation for presenting this report has made it necessary to withhold from the report herewith many interesting examples of bridge failures and methods of repair. All of these, however, will appear in the Proceedings of the association when published.

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Discussion

Discussion of this report centered largely around the question of responsibility for the maintenance of the various units on movable bridges. It was cited that on some roads the bridge operator reports to some officer in the transportation department,

while on others he is a signal department employee and on still others, he reports to the supervisor of bridges and buildings. It was brought out that similar variations occur in the methods of maintenance, on some roads the turning machinery and rail lifts being maintained by the mechanical department and on others by the bridge and building forces. On all roads the electrical equipment and signaling equipment are maintained by the respective departments having jurisdiction, while the bridge and building department maintains the bridge itself.

Speed restrictions also were considered and it was brought out that these vary from six miles an hour to no restrictions. Certain old bridges have rail locks that are not safe for high speeds and the roads having such construction place severe speed restrictions over them as a precaution.

On long spans on north-and-south lines it sometimes occurs that during the morning hours, the easterly truss expands much more rapidly than the westerly truss, sometimes causing trouble in locking the bridge. To prevent this, the Louisville & Nashville has put a galvanized sun shade on one side of a long span to prevent its heating up too rapidly in the morning.

Recent Developments in Field Methods In the Construction of Timber Trestles

Report of Committee

THE main developments in field construction methods can be segregated into the following classifications:

1. The development of a practice of making a preliminary investigation and survey to determine the requirements of the new structure.
2. The improvement of the procedure for advance planning to carry out the work in the most efficient and economical manner.
3. Preframing of timber and improvement in general detail.
4. The increased use of power tools to supplement hand tools.
5. The improvement in pile-driving equipment.

A. S. Krefting
Chairman

Preliminary Survey

Before any plans are made for building a timber trestle, a survey should be made to determine the main requirements for the new trestle. This survey should, if possible, be made not later than the fall preceding the year of construction, in order that necessary plans can be prepared and proper arrangements made for the economical and orderly purchase and delivery of the required materials.

The principal features to be considered in this survey are those which will effect the length of the new trestle, its grade line and alinement, and the proper spacing and design of the trestle bents. The length of the new structure should be checked carefully to make sure that it will be sufficient to meet the local requirements, and also that no more trestle is being constructed than is necessary. In many instances, owing to changes in the local drainage conditions, it may be possible to fill a section of the trestle or perhaps to install a culvert and fill the entire trestle. The possibility and economy of changing the course of any stream in order to shorten the required length of trestle or to improve its capacity and reliability for handling flood water should be investigated.

All available information should be secured on trestles spanning streams as to the high and low water stages, the velocity of the stream during high water periods, and the possibility and probable extent of any scour, as all of these factors will affect the arrangement and design of the new structure. It may also be advisable, in the case of stream bridges, to change the alinement or location of bents or piers within or adjacent to the waterway area, or to increase the length of the spans over the channel to eliminate trouble with ice or debris, and this phase should be covered by the survey.

The location and alinement of bents in bridges spanning highways should be investigated to see that they are placed to provide the maximum opening for the highway and to fulfill all legal and other requirements of the highway authorities. The grade and alinement of the tracks approaching and passing over the trestle should be considered to determine if a change in grade or alinement of the bridge is advisable either to improve conditions at the bridge or general track conditions in the vicinity.

A sketch should be furnished, showing the location of the existing bents in any trestle to be redriven and a recommended location for the new bents. Any special condition to be encountered in the driving and the estimated amount of pile penetration should be noted. It is perhaps unnecessary to point out to men who are familiar with current railway bridge rebuilding programs that this survey should also determine if the old bridge cannot be carried along for at least one or two more years.

Advance Planning

With the results of the survey, the bridge and building supervisor and the division engineer have sufficient information on which to base their recommendations for the new structure. Estimates of cost are then usually prepared and a request is made to the management for approval of the work.

Special plans should be prepared for any arrangements or details not covered by the standard trestle plan and arrangements made for the delivery of the required materials. On some roads, small driving diagrams are prepared on regular printed forms, showing the spacing of all bents in both the new and the old bridges, and these are furnished the foreman in charge of the pile-driving work. Such diagrams save possible confusion in the field as they show the spacing proposed for all bents and the locations

where it is intended to use the various lengths of piles.

All work of rebuilding timber trestles should be programmed for the season, consideration being given to all factors which warrant carrying out certain projects at a given time. Some bridges may be redriven early in the season to avoid interference with heavier traffic at a later date, while at other locations it may be advisable to defer until some later date work which might clog the channel of a stream with additional piling during the high water period.

The kind and quantity of equipment to be used, the method of construction to be followed, and the determination of the most suitable place for storing piling and timber, for setting and outfitting cars and for tying up work trains must be determined in advance to avoid any unnecessary delays after the work is once started.

There has been considerable improvement in general field bridge construction practice, such as more careful "spotting" and driving of piles in their correct location, more accurate cutting of pile tops and placing of caps to obtain uniform bearing, and more efficient handling and placing of stringers and other large timbers through the use of hand derricks or power cranes. The major improvements, however, are those which were necessary in order to obtain the greatest possible life out of treated piles and timbers.

All of the Timber in This Pile Trestle, Except the Bracing, Was Preframed Before Treatment

Preframing of Timber

In order to eliminate all unnecessary field cutting and boring in treated timber, some roads are preframing their timber before it is treated. This practice necessitates greater accuracy and care in field methods, but when the supporting bents are properly driven, the deck timbers can be placed with a minimum of field cutting and boring. The use of preframing methods is also proving very economical, especially when proper machinery is provided at the fabricating yard. An eastern road that has preframed the greater part of its bridge timber at a centralized plant for more than 10 years, has reported that its preframing costs are less than half what they would have been if the timber had been framed in the field.

Power-Driven Tools, Both Electric and Pneumatic, Are Gaining Widespread Acceptance in Bridge and Building Work

One of the photographs shows a typical open deck treated pile and timber bridge constructed recently by a southern road, on which all of the deck timber was preframed. This bridge is 360 ft. long and located on a 2 deg. 30 min. curve, but it was not necessary to rebore any of the holes or cut any of the timber. The only field boring that was done on this bridge was for the holes necessary for attaching the sway braces to the piles.

Requires Careful Driving

It must, of course, be recognized that the success of preframing bridge timber depends largely on getting the bents driven in their exact planned location, and that this in turn depends upon the character of the soil into which the piles are being driven. At locations where it is impossible to hold the piles in their correct position during driving, it will probably be impractical to preframe the stringers.

The practice of preframing bridge timber is, however, generally satisfactory, and some roads are extending the practice to cover the framing of untreated timber, such as guard rails and bridge ties which are dapped for steel spans.

No notching of treated piles, and very little of untreated piles should be permitted to secure a good fit of the bracing. Where braces cannot be pulled up tight against the side of a pile, a filler block should be used to take up the space between the brace and the pile. Where the cutting of treated timber or piling cannot be avoided, the cut surface should be treated with a liberal application of hot creosote, followed by a seal coat of hot coal tar pitch.

Use of Power-Driven Tools

Power-driven tools are being used very extensively on many roads, although many other roads have as yet found it economical to use them to only a limited extent. The economy of using power-driven tools will, of course, result only if there is a sufficient program of work to keep the equipment working during the greater part of the year, and if the jobs are of sufficient magnitude so that the machine has a chance to demonstrate its efficiency. There is little doubt, however, that on any fair sized bridge job power-driven tools, such as wood-boring machines and power saws, will more than earn their carrying charges.

Pneumatic tools have been used successfully on many roads for a number of years. This type of tool can be used to advantage, particularly when a pile driver, a power crane, or similar equipment is on the job which can furnish the required air supply and eliminate the necessity for an air compressor. A photograph shows a pneumatically-driven saw in use on a typical bridge job for cutting off stringers.

In recent years, electrically-driven tools are being widely used, due mainly to the development of light-weight portable gasoline engine-driven electric generators. The apparent advantages of such equipment are that the power plant unit can be shifted readily from one location to the next as the work progresses and that the flexibility of the electric cables leading to the power tools permits them to be

moved around with very little hindrance.

One western road reports that power tools used by a typical bridge crew on its line consist of an electrically-driven saw and two electrically-driven drills, together with the necessary portable gasoline-driven electric generator for supplying current to these tools. This road reports that with the power-driven saw two men can do the sawing that it previously took six men to do by hand, and that with the power drill one man can take the place of six men with hand drills. Power tools driven through flexible shafts from portable gasoline engines are also available now which show promise of being satisfactory for many types of work.

Where the program of bridge work for any one bridge crew is so limited as to make it uneconomical to assign special power-driven tools to that crew, the benefits of such tools can still be obtained by having division or system equipment that can be sent to the various gangs that have work under way that warrants the use of such equipment.

Pile-Driving Equipment

The type of pile-driving equipment that will prove most economical will depend, to a large extent, on the amount of pile-driving work to be done and the use for the machine during "off-season" periods. The so-called "regular" track pile driver, with leads attached to the framework of the driver is a machine that is familiar to all railroad bridge men. The general arrangement for this type of driver was developed a long time ago, but as time went on the various parts were altered and improved until they resulted in the present modern track pile driver. The principal improvements in the pile driver consist in the substitution of a steam hammer for the old drop hammer, the substitution of steel leads and steel body framework for the former wooden leads and framework, and the improvement of the hoisting machinery and the arrangement for raising and lowering the leads. Most modern drivers can travel under their own power and the table of the driver can be rotated by means of the driver's machinery. With this type of equipment, piles on most railroad trestle work can be driven accurately and economically.

The rigidity of the leads is especially valuable when driving piles which have a tendency to go out of line. The "regular" track type driver has the disadvantage that it can be used only for pile-driving work. On roads which have a large program of driving work and which are so located that driving work can be carried out during the greater part of the year, this may not be a serious drawback.

Crane With Leads

Another type of equipment that is working out to good advantage on many roads consists of a locomotive crane with about a 50-ft. boom, a steam-driven pile hammer, and a set of demountable leads which are suspended from the boom. Such a machine is shown in a photograph. This type of machine is self-propelling, and no work train is required to handle it to and from the nearest

Locomotive Cranes, Eqiupped As Pile Drivers, Are Being Used to Good Advantage on Many Roads

siding, although certain state regulations and working agreements may make it necessary to have some members of a train crew with the equipment. The leads and pile driving equipment can be removed from the machine readily, and it can thus be used alternately as a crane or as a pile driver. The driver illustrated has a horizontal strut extending from the lower end of the boom to a connection with the leads near their lower end. While such a strut is not entirely essential, it will help materially in keeping the bottom of the leads rigid, thereby avoiding delay in spotting piles and assisting in holding the piles in proper line during pile-driving operations.

This type of machine has the further advantage over the "regular" type of driver with its fixed vertical leads in that the leads can be inclined or tilted to drive batter piles in their proper position. This will eliminate the necessity of any pulling or jacking of the batter piles to get them into proper location after driving, or the necessity of warping the piles while they are being driven to obtain the proper batter.

This equipment has the further advantage that the leads can be lowered below the level of the deck for driving piles with a low cut-off, such as foundation piles for frame bents or concrete piers, and the leads can also be suspended over the outside of such obstructions as high through plate girders for driving piles which could not be reached with the "regular" type track driver. Ordinarily a crane type of driver with a 50-ft. boom can drive piles located as far away as 35 ft. from the center of the track.

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Discussion

A Chinn (Alton) emphasized the desirability of utilizing power tools to the maximum extent possible. In connection with the discussion of the use of power tools, the question arose as to the amount of power required for operating saws and then turned to the relative advantages of electric and air-operated small tools. The advocates of pneumatic tools preferred them because compressors are universally available and because electric tools must conform to the characteristics of the generator. The advocates of electric operation stated that they preferred this form of power because both the tools and the generator are lighter than pneumatic equipment and are suitable for lighting plants if night work must be done. The question of grounding electric tools to prevent shock, especially during foggy weather, was also discussed at some length and it was concluded that this is a necessary precaution in the use of electric power.

H. R. Duncan, (superintendent of timber preservation, C.B. & Q.) emphasized the desirability of preframing bridge timbers because omission

of this precaution is the cause of failure of a great deal of treated wood. "Where material is not preframed," he said, "the untreated wood below the zone of treatment is exposed to attack by decay-forming organisms in much the same manner as wood that is not treated." He also stated that he has seen concrete and steel structures that require more maintenance than treated trestles of the same age where complete treatment and complete preframing have been done.

D. C. Barrett (C. & N.W.) called attention to the fact that there is often a variation in the height of treated stringers of from 1/8 to 5/8 in. and that in some cases this variation reaches 3/4 in. A. L. McCloy (P.M.) also had similar trouble with stringers which had been purchased from commercial treating companies. A. Hamblin (L. & N.) stated that on his road timber was ordered sized, the sizing being done after seasoning. No green timber is used for bridge work on this road and there has never been any trouble with either oversize or undersize timbers.

Mr. Duncan stated that for a number of years, the Burlington had used Douglas fir which was surfaced at the mill but that shrinkage during seasoning had created so great a variation that it is now the custom to purchase bridge timbers in the rough and surface them after they have been seasoned. Since the later practice has been started, no trouble has been experienced with shrinkage.

Mr. Barrett inquired whether shrinkage will occur after treatment and the discussion brought out the fact that if the timber is air-seasoned before being sized, there is little likelihood of shrinkage but that if an attempt is made to treat the timber green it is necessary to condition it artificially by steaming and that in this case considerable shrinkage may take place, but, as Mr. Duncan stated, this should not reach 3/4 in.

The discussion then turned to the handling of piles that are wider than the caps and several of the members explained their practices in cut-off protection, the general consensus being that piles wider than caps should not be chamfered but that the exposed cut-off surface should be treated with hot creosote and protected by roofing felt and hot tar.

Much time was also given to a discussion of the details of trestle construction and the desirability of getting away from the use of drift bolts. During this part of the discussion, Mr. Chinn called attention to that part of the report which suggested the desirability of preliminary surveys to insure that sufficient waterway will be provided but that the trestles be shortened as much as is safe.

George Rear (S.P.) called particular attention to the fact that stringers should be side cut, for where the pith is boxed it is certain that the timber will split from the end. He explained that the side cut timber should not be cut closer than 2 in. to the center of the log to avoid the pith.

The Possibilities and Limitations of the Acetylene Cutting Torch

Report of Committee

WHEN this subject was assigned to the committee, it was at first thought that a worth-while report could not be prepared on the uses of the cutting torch without including the work of the welding torch, as the two are so closely related. However, as the committee entered upon its work, it was seen that the cutting torch possesses so many possibilities that it became apparent that it would have to condense its report in order to keep it within the time and space allotted to it. Therefore, this study will be limited to the uses of this tool, to the exclusion of consideration of the proper method of using and caring for the tool itself.

J. L. Varker
Chairman

The oxy-acetylene cutting torch is an infant, measured by the number of years that other mechanical tools and machinery have been used for cutting metals. It is only a little more than three decades ago that this tool was developed. It employs the principle of combustion. When flame is applied to wood, the temperature of that portion in direct contact with the flame is raised to the point at which it unites with the oxygen in the air. At this time, ignition has taken place and the piece of wood continues to burn until consumed. Steel will also burn in an atmosphere of high purity oxygen after a portion of it is once heated to its kindling or ignition temperature. Like the piece of wood, it will continue to burn until consumed. The cutting torch is a special tool for providing the means of pre-heating the ferrous metal to be cut to its kindling temperature and then the means of applying a jet or stream of oxygen which supports the combustion that has been started.

This tool, in the hands of a skilled workman, has a legion of uses. It has wrought a profound change in industrial practices. Since its advent in this country, it has provided the means for severing ferrous metals at a fraction of the cost incident to the only other methods previously available through mechanical measures that employ considerable power or through laborious and time-consuming hand methods. It cuts both light and heavy sections quickly and with practically the same economy. Its flexibility permits the cutting of irregular and complicated shapes. Its portability allows the tool to be taken to the work, which otherwise would often be inaccessible to mechanical cutting devices. The initial cost of oxy-acetylene cutting equipment is very low in comparison to that of mechanical cutting devices capable of performing similar work. Quite often one can accomplish with the cutting torch what otherwise would require the use of several mechanical machines and tools. It has another advantage over mechanical devices in that it is practically noiseless in operation. This is a valuable feature,

especially when it is necessary to perform cutting operations in a district where noise is restricted.

The committee prepared and sent a questionnaire to railroads in different parts of the country. The answers provide a good cross section of the practices now being employed on the railroads of this country. The report, from this point on, will be largely a summation of these answers.

Operators

It was found that operators of oxy-acetylene equipment are specially selected on the majority of railroads. They are given special training in most cases by a representative of the supply company furnishing the equipment and gases. In other cases, they receive instructions and practical training from representatives of the supply companies in schools conducted usually in shop buildings at different points on the system. Classes are usually held for a few hours once a week, extending for several weeks. Such training is very valuable as the student not only gets practical training, but he also receives instructions in the proper handling, use and care of the equipment as well. He learns to know metals and their technique of cutting and welding. In some instances, operators receive training only from a more experienced workman.

The committee feels that proper training should be given all users of oxy-acetylene equipment. To permit inexperienced persons to use it is dangerous and, besides, poor workmanship is harmful to steel, as well as uneconomical in labor and materials. Untrained men waste gases and quite often spoil the work. It was found that, in most cases, operators must pass a qualification test before being permitted to engage in cutting operations and, in a few instances, that the operators have been required to secure special licenses.

The number of qualified men in each gang depends, of course, on the size of the gang. Where a gang is composed of 10 or 12 men, the number of operators varies from 1 to 4. Steel gangs usually have the largest number of qualified men. On some railroads a differential of five cents per hour is established in their rate of pay. On other roads, there is no difference. Some roads give their operators initial and periodic eye examinations while others do not. Operators should wear proper clothing and suitable protection for their eyes, hands and feet.

It was found that the following gangs used the cutting torch—carpenter, steel, water service, plumbing, dock-building, machinist, sheet metal workers, and bridge gangs. Steel gangs, as a rule, make the most use of the cutting torch. Cutting operators in most cases are part of the regular bridge and building forces.

Equipment and Supplies

Special tips are used on some roads to cut out rivet shanks that cannot be backed out. Some roads also use a special low-velocity nozzle for cutting off rivet heads prior to backing them out, while others use the regular cutting tip. However, the best results can be had by using a special tip.

The Oxy-Acetylene Cutting Torch Is Indispensable to Many Types of Bridge Strengthening and Repair Work

Some roads do not permit the cutting of rivets by means of the torch. In cases where special tips are used, it is stated that a considerable saving in labor is made. A mechanically-guided torch is used on one road for cutting circular plates and billets. On another road, it is used for cutting rail and on still another road for beveling pipe for welding purposes.

The oxygen lance is not a cutting torch in the strict sense of the word. Nevertheless, the principle of the two tools is the same. The lance is used where the thickness of the metal to be cut is greater than the nominal working range of the regular cutting torch. On one road, the lance was found to be used in bridge and building work for cutting out rivets in heavy sections where several thicknesses of plates are riveted together, piercing holes in sections two to eight inches thick and cutting out broken hanger bolts in turntables. On another road, it is used for removing obstructions in deep holes in structural members.

Supplies of oxygen and acetylene are shipped direct to the job from a central supply on some roads, while on other roads the gases are carried in the outfit cars provided for the different gangs.

Metals and Methods

Low carbon iron and steel are metals of relatively high cutability. Castings and alloy steels are metals of relatively low cutability. Those of the first group are easily cut, while special technique is required to cut those of the second group. Cast iron, coming within the second group, requires special manipulation of the torch in order to cut it properly. Increased pressure of the gases is also necessary. The answers to the questionnaires reveal that comparatively little cutting of cast iron is being done in the bridge and building departments of the railroads. It is acknowledged that it is more expensive to cut cast iron than steel of equal thickness. However, it can be cut with reasonable speed by a skilled workman.

Some years ago, one of the eastern railroads experienced trouble with the breakage of a 16-in. cast iron water main. In making the repairs, trouble and delay were encountered in cutting out the broken section with a hammer and chisel. Studies were made of the possibility of using the cutting torch for this work, and after some experiments, they were able to cut the pipe successfully.

Other resistant materials also require special technique for cutting. High carbon and alloy steels, if pre-heated, can be cut more easily and economically. Heavy cuts are aided in starting by preliminary under-cutting. Structural steel from two to eight inches thick has been cut by regular cutting torches in the bridge and building departments of the roads submitting answers to the questionnaire. It is said that cuts up to 24 in. thick can be made by a hand-guided cutting torch up to 33 in. by a machine-guided torch.

It is said that a clean smooth flame-cut edge of plain carbon steel of the non-alloy variety which contains less than 0.35 per cent of carbon is not injured by the cutting process. In fact, it can be said that such flame-cut surfaces are improved by being left in a slightly harder and tougher condition. High carbon or alloy steels should be pre-heated to a temperature of 500 or 600 deg. F. before cutting to prevent checking and crack-

ing. Annealing or normalizing after cutting is not necessary, as a rule, when the metal has been pre-heated. On the other hand, if the metal to be cut is not pre-heated, normalizing after cutting is necessary to relieve the severe stresses.

Uses of the Cutting Torch

A few of the more common uses of the cutting torch in bridge and building work are listed below:

Reframing steel for repairs and alterations.

Fabricating and erecting structural steel.

Cutting wreckage and damaged parts.

Demolishing structures, thus saving false work.

Cutting up old bridges, framework, etc.

Cutting reinforcing rods in new and old work.

Cutting and shaping parts to be welded.

Cutting plates to intricate shapes and patterns.

Cutting bolts, rods, etc.

Beveling edges prior to welding.

Burning out paint deposits before welding.

Cutting holes in unimportant bridge members.

Piercing holes by means of the oxygen lance.

Melting out lead joints in cast iron pipe lines.

Cutting cast iron and other pipe.

Cutting bolts in angle bars when relaying rail.

Removing flowed metal.

Melting ice from bridges

Fabricating pipe fittings.

Cutting and welding branch pipe lines into main pipe lines.

Unusual Uses

The cutting through several thicknesses of plates simultaneously is known as "stack flame cutting." It is accomplished by clamping the plates together as nearly as possible along the line of cut.

Under water cutting is accomplished by means of special equipment.

The use of the acetylene flame for illumination purposes in emergency night work is another unusual use.

Still another is the use of the oxy-acetylene flame for removing heavy rust scale from bridge stringers, lateral bracing, etc.

The acetylene torch is used with success on one of the eastern railroads for providing clearance between bridge girders and backwalls in cases where the walls have shoved in against the girders. These walls are mostly of granite, native to that part of the country, and the work is usually done during the winter in order to take advantage of the greater expansion when the flame is applied to the cold stone. This road has had some success in the summer by heating the walls and quenching the area heated with cold water. It is stated, however, that the granite flakes off in relatively small pieces and does not fly fast enough to clear the bridge seat.

Some years ago the cutting torch was used extensively on a large western road in connection with some major repairs to a double-track bridge. It is estimated that the cutting totaled approximately one mile in length. More recently in the eastern part of the country, a reinforced concrete over-head highway bridge, which had been condemned, was dismantled to make way for a new structure on the same site. It spanned the main and yard tracks of three different railroads and one city street. Eleven truss spans, each more than 100 ft. in length, made up the structure. Each span in its turn was cut with the torch and dropped to the tracks, which were blanketed with old ties and timbers. It was then pulled clear of the tracks, cut up and disposed of.

The majority of the roads do not permit cutting of main track rails, but do allow side track rails to be cut by gas. Neither do they permit cutting holes in the webs of rails. One road allows main track rails of not more than 100 lb. to be cut. Only a few railroads allow the recutting of rivet holes before reaming in bridge connections where the holes do not line up properly. The cutting of holes instead of drilling is allowed only in unimportant work. In most cases the cutting of small holes and reaming are not allowed.

The following operations are permitted by the majority of the railroads—cutting structural members, rivets, cast iron bridge parts, stiffener angles to obtain an easier fit and the cutting of tension members. Where the latter is done, the irregularities on the cut edge are, as a rule, removed by grinder or chisel to eliminate the concentration of forces and incipient fractures. Other operations not permitted are cutting around coal chutes or docks of timber construction where the fire hazard is present, cutting in grain elevators where dust explosions might occur and the plugging of rivet holes. Where holes are cut and reamed, the requirements are that from 1/8 in. to 1/4 in. be reamed beyond the cut edge. The majority of the roads permit cutting bolts, etc., of timber structures, providing means are taken to prevent fire. These may be as follows—a fire extinguisher, pails of water or hose, wetting the timber all around ahead of the cutting, covering the timber with wet sand or dirt and shielding with sheet metal or asbestos. Some roads do not permit any cutting an hour or two before the crew quits for the day, or at dinner time. The precaution taken against flying sparks is the use of metal shields. The torch should never be used in confined places which are not adequately ventilated.

This report can be summed up by saying that the field of possibilities for use of the oxy-acetylene equipment is constantly enlarging and the limitations of cutting have not yet been reached.

Committee—J. L. Varker (chairman), b. & b. supv., D. & H., Carbondale, Pa.; R. W. Johnson (vice-chairman), asst. engr., C. M. St. P. & P., Chicago; Armstrong Chinn. chief engr., Alton, Chicago; M. H. Dick, eastern ed., *Railway Engineering and Maintenance*, New York; W. J. Lacy, b. & b. supv., M. P., St. Louis, Mo.; K. L. Miner, supv. b. & b., N. Y. C., Beacon, N. Y.; T. E. Snyder, mast. carp., B. & O., Salamanca, N. Y.; C. W. Wright, mast. carp., L. I., Jamaica, N. Y.

Discussion

Elmer T. Howson (*Railway Engineering and Maintenance*) called attention to the fact that this report is a definite indication of changing practices and that nowhere can information regarding these changes be secured except at meetings of associations similar to that of the American Railway Bridges and Building Association, because current literature on the subjects of these changes is generally widely scattered and this information, together with that possessed by experts in the use of equipment and materials is brought together in reports similar to this one. Men attending meetings can take these ideas home and apply them on their own roads. He also called attention to the fact that, while a large number of applications of the cutting torch were listed in the report, a study of the subject matter will suggest other applications.

A. Chinn (Alton) threw out a word of caution on the use of the cutting torch, stating that it is so handy a tool and so easy to operate that workmen will sometimes use it where it should not be used. F. H. Masters (E. J. & E.) also called attention to the fact that unless supervision is adequate, operators will sometimes take unnecessary risks in the cutting of materials.

The discussion then turned to the question of cutting rails by means of the oxy-acetylene torch. It was brought out that certain roads permit the use of the torch in cutting rails, while others prohibit it.

Lem Adams (Oxweld Railroad Service Company), in answer to a question, stated that the carbon content of steel determines the stresses in the steel when the cutting torch is used. No stresses will be set up in low carbon steel, that is 0.35 or lower, after the use of the cutting torch, while in high carbon steel, stresses will be created, varying with the increase in the carbon content and high carbon steel must be normalized after cutting to insure safety. Rail of any size can be cut safely with a torch if it is preheated and again heated after the cut is made. He also emphasized the importance of training men who are using the cutting torch, especially in the proper handling of oxygen and acetylene gases in order that safety may be fully conserved.

The Inspection and Preparation of Wood Surfaces for Painting

Report of Committee

THE preparation of wood surfaces prior to the application of paint probably receives less consideration in relation to its importance than any other individual detail in the maintenance of railway property. This is due to several causes, of which the most outstanding appears to be a general lack of knowledge of, or indifference to, the benefits accruing from the proper preparation of wood surfaces before the application of paint.

The use of paint in the home unquestionably influences the attitude taken by many that the cost of the paint is the only financial outlay involved and that any elaborate preparation of the surface seems quite unnecessary, more interest being taken in the immediate effect than in the ultimate destiny of the job as a whole. The use of paint industrially requires more detailed study where the costs of labor and of material go hand in hand and where the aim is to effect the greatest saving from the use of the materials available.

Inspection of Surface

Before any wood surface is painted, a thorough inspection should be made by a competent person to determine the condition of the surface, the kind of wood, and the method of treatment that the surface should receive; and the inspector should have a knowledge of the best type of paint suitable for the purpose. This preliminary inspection is necessary for both old and new surfaces, and its importance cannot be stressed too much. For instance, woods such as southern yellow pine, ponderosa pine, Douglas fir, hemlock and spruce have wide bands of spring and summer wood, on which it is more difficult to secure the adhesion of paint, necessitating more careful selection of the priming coat. Also, certain woods contain soluble oil wood stains, and unless they are properly treated prior to final painting, the results will be unsatisfactory.

T. D. Saunders
Chairman

This preliminary inspection should be made by the supervisory officer who has complete charge of the work to be undertaken, and, where possible, he should discuss the general outline of the procedure to be followed with the paint foreman at the job.

New Wood

The term new wood, as applied here, is understood to mean wood that has been reasonably well seasoned but has never been painted and has not been unduly exposed to the weather since milling. Weather-beaten "new wood" comes under the category of previously painted wood surfaces that have deteriorated, and is treated under that heading.

The first step in the preparation of a new wood surface is to make sure that the wood is thoroughly dry before work is started. The wood should not only be dry on the surface to be painted, but care must be taken to see that no excessive moisture is within the wood or on any hidden surface. If there is any indication that water has access to the back of any surface to be painted, steps must be taken immediately to correct this condition as this is one of the fundamental causes of early failure of painted surfaces. The work should be undertaken only under favorable weather conditions and should not be attempted after a heavy rain or mist until sufficient time has elapsed to allow complete drying, or at a time when it may reasonably be expected to rain before the first coat of paint has been applied and is dry enough to touch.

Having made certain that the wood is dry, all knots and pitch pockets should be gone over with shellac and nails should be set carefully. Nail holes, cracks and blemishes should be primed and then caulked with putty. Thorough sandpapering of the surface is very desirable, particularly if the grain of the wood has risen due to the presence of moisture. Sandpapering also removes any dirt or oil which may have adhered to the surface but cannot readily be seen.

When new construction allows, the treatment and painting of the back surfaces of all appplied members is desirable and in many cases necessary. Any of the woods containing large quantities of natural wood stains, such as redwood, must be back-painted to prevent this stain from bleeding from the surface.

Where excessive stain bleeding persists, it becomes necessary to treat the surface with some form of impervious primer; aluminum paint with a good elastic long oil vehicle content is generally recommended for this purpose.

Previously-Painted Surfaces

The inspection of previously-painted wood surfaces should be even more exacting than that for new wood. Such surfaces require more individual treatment and the amount of preparation necessary depends on a variety of conditions that are de-

termined only by thorough inspection and knowledge of what is required.

Excepting unusual conditions, paint deteriorates from the surface inward. On exterior work the surface first shows signs of weathering, that is evidenced by the surface becoming dull and the corroded pigment smearing or rubbing off. More progressive deterioration shows signs of checking, blistering or cracking and finally the paint peels from the wood entirely.

Where the surface has merely become dull and no blistering or cracking is evident, it is sufficient to wash the surface with mineral spirits or some good cleaning solution to remove any oil or dirt and the corroded pigment. The surface is then ready to repaint when thoroughly dry. If there is any noticeable checking, blistering or cracking, the parts so affected should be removed.

Removing Old Paint

When paint has deteriorated to such an extent that all or part of it has to be removed from the wood, the question arises as to the best means of doing so. For the general type of wooden building on which the paint has cracked or curled, it is sufficient to remove only such of the old paint as can be taken off with a heavy scraper. A good tool for this purpose can be easily made from an ordinary track shovel by cutting the blade down to about 4 or 5 in. square and grinding the scraping edge to a slight bevel. More pressure can be applied with a tool of this sort than with any small hand scrapers, and any paint remaining can be relied upon to adhere to the wood throughout the life of the new paint job.

Thorough sandpapering should then be done over the whole surface, particularly at the edges of all remaining paint to reduce them to a feather edge. This method of removal costs less than any other, and for most types of exterior surfaces gives very satisfactory results.

Another method of removing paint is by the use of chemical compounds known as paint removers. This method is to be used only in special work where the surface to be repainted does not lend itself to the usual scraping or brushing or where the appearance demands a high class smooth finish, such as interiors and wood surfaces that bear close inspection. These compounds are excellent where surfaces must show no bruises or scratches, or where a natural or stained finish is reapplied.

There seems to be no deleterious effect on the wood surface from the use of paint removers if the surface is thoroughly washed with water afterwards to remove all chemicals. However, washing tends to raise the grain of the wood and consequently requires thorough sandpapering. If the old paint is very thick, chemical removers are not very effective. This is the most costly method, due to the extra labor and material necessary, and its use should be avoided except for unusual work.

It Would Be Practically a Total Waste of Money to Paint a Surface Like This Before It Is Adequately Cleaned

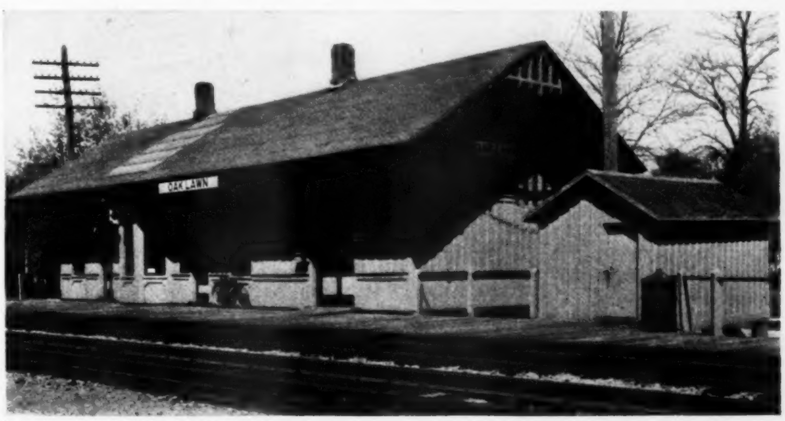
Burning Paint Off

If carefully done, paint may be removed from wood satisfactorily by burning. There are many arguments against the use of this method, the main objection being the hazard of fire where an open flame is used. If burning is resorted to, it is best that the work be not carried on after the middle of the afternoon so that if any sparks have caught in the back of mouldings or crevices there will be every likelihood that they will be observed prior to leaving time. Care should also be taken not to burn or scorch the wood surface. On wood having a considerable pitch content there is a tendency to boil the pitch out, which necessitates the application of shellac to stop pitch bleeding. Regardless of which method of removal is used, the procedure afterwards should be exactly the same as for new wood.

The interval of time between the final preparation of the wood surface and the first application of paint should be as short as possible. No matter how well applied or how good the quality and type of paint used, if the initial preparation is not carried out thoroughly the job will be a failure. The intimate association of the act of preparing the surface with the actual painting operation itself is such that the effectiveness of both depend on the thoroughness of each.

The question of the paint to be used and the manner of applying it are not pertinent to this discussion, having been fully covered in a paper by F. L. Browne, senior chemist of the Forest Products Laboratory, printed in the 1936 Proceedings.

T. D. Saunders (chairman), asst. div. engr., C. N., Toronto, Ont.; G. E. Boyd (vice-chairman), associate editor, *Railway Engineering and Maintenance*, Chicago; G. S. Crites, div. engr., B. & O., Punxsutawney, Pa.; H. Cunniff, gen. painter for., D. & H., Watervliet, N. Y.; G. W. Henrie, b. & b. insp., C. & O., Okeana, Ohio; S. E. Kvenberg, asst. engr., C. M. St. P. & P.,



An Adequate Cleaning Job Is Essential to a Good Appearing, Long-Life Paint Job

Chicago; O. R. McIlhenny, rdm., T. C. I. & R., Ensley, Ala.; L. E. Peyser, asst. arch., S. P., Stockton, Cal.; J. H. Pyle, for. b. & b., M. P., Falls City, Neb.; T. E. Vieth, supvr. b. & b., Sou., Louisville, Ky.; R. A. Whiteford, div. engr., C. M. St. P. & P., Ottumwa, Iowa.

Discussion

The discussion of this report centered largely around the burning off of deteriorated paint. G. E. Boyd *(Railway Engineering and Maintenance)* spoke of the use being made by at least one road of special propane gas paint-burning torches. These he described as specially designed torches, worked in pairs, from a single gas cylinder, each operator doing his own scraping of the blistered paint. He said that the flame of the torch is not as hot as the gasoline or acetylene flame, and that, as a result, there appeared to be less tendency to scorch the underlying wood.

W. J. Lacy (M.P.) said that he had recently witnessed a demonstration of a special gas-burning paint-removing torch, and, after describing the torch, which was similar to that mentioned by Mr. Boyd, he wanted to know the best method of further cleaning the wood surface for painting after the torch had been used. Answering him, B. F. Cary (Southern) told of his experience with a special nine-hole acetylene burner for removing badly deteriorated paint, and said that as one man operated the burner, two other men followed the burner closely, scraping off the paint before it became cold. Immediately behind them, he said, two men followed, sandpapering the surface.

G. S. Crites (B. & O.) suggested that where air is available, as when spray painting, certain air-driven wire brushes and sanding machines could be used to advantage. Answering a question raised by F. H. Masters (E. J. & E.), it was brought out that because of the expense involved, especially in hand sandpapering, it was not the intention of the report to recommend sandpapering as a general method of preparing surfaces, but only where there was any raising of the grain of the wood due to weathering.

Coming back to the question of burning, K. L. Miner (N.Y.C.) told of the success which he had had with gas-burning paint-removing torches. He described these torches as having a fan-shaped burner, 4 to 5 in. wide, which is operated by one man, who does his own scraping.

Answering a question raised concerning the practicability of sandblasting wood surfaces, Mr. Lacy said that he had had no experience in this regard, but that he did not recommend the use of the sand blast for cleaning brick surfaces. The blast, he pointed out, removes much of the mortar in the joints, requiring an excessive amount of repointing. For cleaning brick, he recommended consideration of a chemical method which has been used successfully on his road.

Closing the discussion, W. A. Sweet (Santa Fe) told briefly of a sandblasting machine which had been developed on his road for removing the paint from refrigerator cars in preparation for repainting. He said that this machine, which has a small, flat nozzle which delivers an even flow of sand, has been used with large success for cleaning refrigerator car siding, but that he had never seen it employed in connection with any kind of building work.

The Insulation of Railway Buildings

Report of Committee

WHILE a large number of railway buildings have been insulated against heat loss, and a few roads have given special attention to this phase of building construction in recent years, the railways as a whole are not insulation conscious and lag considerably behind industry generally, and the home-building industry in particular, in the general acceptance and use of this material.

These conclusions must be drawn from replies to a questionnaire sent out by the committee, in which 59 representative roads of the United States and Canada, large and small, representing all sections, advised of the extent to which they have already used or are now contemplating using the various forms of thermal insulation in building construction, other than for cold storage or other refrigerated buildings. It is evident from the replies that this situation has been accentuated during the last seven or more years by the lack of funds for building construction and maintenance; that there is a growing appreciation of the economies and other benefits to be derived through the proper use of insulation; and that with a revival of railway building construction and maintenance programs, a much wider use of insulation can be expected.

Neal D. Howard
Chairman

The report of the committee this year is essentially a continuation of the able report on this subject presented to the association last year. In that report, the committee described in some detail the theory of heat transfer; the various classes and the properties of insulating materials available; their application to new and existing structures; their relative resistance to heat transfer as compared with uninsulated construction; and, in the abstract, the recognized economy and other advantages to be gained through the effective use of insulation. In compiling the present report, the committee, realizing that it could add little of a fundamental nature to the character of the data already presented, endeavored to ascertain the attitude of the railways concerning insulation; the extent to which it has been used in new construction and in existing structures; the types of insulation and methods employed in installing it; and the advantages resulting through its use.

The extent to which insulation has been used in railway buildings, according to our investigation, varies widely, both as between roads and

between different sections of the country. The more northerly roads, as might be expected, with the incentives of larger fuel savings, more economical heating installations, and increased comfort in winter, have showed much greater interest in building insulation than southern roads. A few southern roads have, however, made isolated applications of insulation, usually on roofs or ceilings, to keep out summer heat or to overcome ceiling condensation, or for wall facings as a substitute for some other structural material, where the construction costs were not increased or were actually reduced. On a number of roads serving both northern and southern territories, the use of insulation has been confined almost entirely to the colder climates, the feeling being, in common with that of the southern roads, that the added expense for insulation in the areas of mild winters cannot be justified on the basis of savings in fuel costs.

Two significant features of the data collected are the extent to which some roads have employed insulation, while others in equally as cold or colder territories have taken little or no advantage of it, and the wide range in the types of buildings insulated on the various roads. It is also interesting to note the extensive use of insulation in its various forms by several roads, both in new construction and in building repair and modernizing work.

Extensive Use in Canada

It is impossible within the confines of this report as to be read before the convention to present all of the data collected by the committee relative to the interest of the various roads in thermal insulation, and the widely varying conditions under which it has been applied by these roads, but supplementing the data presented herewith, a considerable amount of this information will appear in the Proceedings of the association to be published later. Reference here is made alone to the use of insulation on the Western lines of the Canadian National, and on the Baltimore & Ohio.

On the Western region of the Canadian National, the recognition of the value of insulation in effecting fuel economy and in increasing the comfort of employees and patrons is evidenced clearly in the fact that on this region alone a total of 865 buildings have been insulated, these including 448 passenger stations, 337 section dwellings and 80 miscellaneous structures. Practically all of these buildings are of frame or frame and stucco construction; the insulation, (1-in. rigid board or 3 or 4 in. of fill-type of various materials) being applied to both walls and ceilings in most cases, and in many instances to ground floors as well. In addition, much has been done in enclosing building foundations to prevent cold ground floors and to insure tight construction about windows and doors. Furthermore, all windows in heated buildings are equipped with storm sash. On this section of the Canadian National, it is estimated that the saving in fuel resulting from insulation is from 25 to 35 per cent, sufficient to pay for the added cost involved in from 3 to 4 years. In addition, in connection with new construction, it is said that it has been found possible to reduce the amount of radiation and boiler capacity required 30 to 40 per cent, effecting substantial economies in this regard.

Many Structures on B. & O.

In the United States, the Baltimore & Ohio is among those roads which have given the most attention to building insulation. This road started the use of insulation for various purposes about 12 years ago, and to date has applied it to varying extent and for various purposes in more than 150 structures, including numerous enclosed exterior stairways and passenger platform shelters, freight houses; piers; warehouses; produce buildings; office buildings; yard buildings; signal towers; 7 passenger stations; 2 pump houses and 63 water treating plants. Altogether, this road has used more than 541,000 sq. ft. of insulating materials of various thicknesses.

From the few examples given, it is evident that considerable thermal insulation, in a wide variety of types, has been used by the railways, and that, in the aggregate, a large number of railway buildings have been treated with insulation to some extent for various purposes. However, the committee cannot overlook or alter the fact that, large as this total number of buildings may be, it represents only a small proportion of the buildings on the railways, heated or unheated, to which insulation might be applied to advantage in one form or another, to the degree that climatic or other conditions may warrant.

Large Economy Has Resulted From Properly Insulating Structures Like This

More Study Needed

One fact brought to the attention of the committee in its study is that, with few exceptions, the railways appear to have made relatively little scientific study or analysis of the possibilities for savings through the use of insulation in their buildings generally, or individually. A few roads have made estimates of the economy that can be effected through the use of insulation in specific structures, but more often than not, these have been based on general assumptions. In other words, it appears that little use is made of the technical knowledge available for determining the economies possible through the use of insulation, in spite of the fact that this information is readily available and the calculations involved are relatively simple.

The fundamental data required in solving any building insulation problem are as follows: The thermal conductivity values of the materials under consideration, (k); the thermal conductance values of such materials, of the specified thickness involved, (C); the thermal transmittance or over-all co-efficient of heat transfer through a wall, roof or floor of the specific construction under consideration, (U); and the resistance to heat transfer through the wall, roof or floor of the specific construction involved, (R).

With these data, all established by the U. S. Bureau of Standards and available in the Guide of the American Society of Heating and Ventilating Engineers, and detailed informa-

tion concerning the specific building under consideration, it is a relatively simple matter to establish the reduction in heat loss in any building as the result of insulation, and, in turn, the actual dollars and cents saving in fuel.

The facts which must be known concerning the building involved include the type of wall, roof or floor construction that is to be insulated; the number of days yearly that heating is required; the average inside temperature desired; and the average outside temperature during this period. With this information, and the aid of established values of (k) (C) (U) and (R), it is a relatively simple matter to calculate the effect of the insulation on heat losses, and then directly, the economic savings, if any, involved.

Example Presented

The following relatively simple example in this regard will indicate the general procedure to be followed.

The problem involved is that of determining the economy of insulating a structure 40 ft. long by 25 ft. wide, by 20 ft. high to the eaves, with a simple double-pitched roof, with the ridge 8 ft. 4 in. above the eaves. The entire building is heated. The walls of the structure have wide board sheathing; a 4-in. brick veneer; and wood lath and plaster interior facing. The roof consists of rigid shingles over wood sheathing, with the underside finished with wood lath and plaster.

Furthermore, in this example, it is estimated that heating will be required for 210 days, for 17 hours each day; that the average outside temperature for this period is 40 deg. F., and the inside temperature desired 70 deg. F., making a difference of 30 deg. F.; that the average wind velocity is approximately 15 miles an hour; and that consideration is being given to insulating the walls and roof of the building with batt or fill-type insulation 3⅝ in. thick.

With the above information and with values of (k) (C) and (R) taken from the A.S.H. and V.E. Guide, it is possible to arrive at the heat transfer co-efficient (U) for the walls, uninsulated and insulated, as shown in the accompanying tabular matter. This is calculated as 0.27 for the uninsulated wall and 0.062 for the insulated wall. Continuing, the calculations show that, on the basis of the wall area and temperature difference involved, the heat loss through the uninsulated walls is 18,468 B.t.u. per hr., against 4,241 B.t.u. per hour for the insulated walls. Likewise, the calculations show the heat loss through the uninsulated roof to be 11,900 B.t.u. per hr., as compared with 2,308 B.t.u. per hr. through the insulated roof, and the combined losses for walls and roof are shown as 30,368 B.t.u. per hr., for the uninsulated structure as compared with 6,549 B.t.u. per hr. for the insulated structure.

In this example, therefore, it has been shown that through the use of the insulation selected in the walls and roof of the particular building under consideration, there is effected a saving of 23,819 B.t.u. per hr. Multiplying this by the number of hours in the heating season of the year, and then dividing the result by the delivered B.t.u. value per ton of the fuel employed, gives directly the saving in tons of fuel due to the use of insulation.

Assuming coal with a B.t.u. value, as delivered from the average heating plant, of 14,000,000 per ton, and a

CALCULATIONS IN CONNECTION WITH BUILDING INSULATION PROBLEM DISCUSSED IN THE TEXT OF THE REPORT

Heat Loss Through Walls Alone

	C	k	Uninsulated R	Insulated R
Conductance of outer surface	6.00		0.167	0.167
4-in. brick veneer		9.20	0.435	0.435
Wood sheathing	0.82		1.220	1.220
3⅝-in. air space	1.10		0.908	
3⅝-in. fill-type insulation		0.27		13.420
Plaster on wood lath	2.50		0.400	0.400
Conductance of inner surface	1.65		0.606	0.606
Over-all resistance (R)			3.736	16.248

Since $\frac{1}{R} = (U)$

Heat transfer coefficient (U) = 0.27 0.062

From the building plans, the following information is available:

Total wall area	2,808	sq. ft.
Chimney area	100	
Wall area less chimney area	2,708	sq. ft.
Windows and doors	428	
Net area to be insulated	2,280	sq. ft.

From the foregoing data, the heat losses through the walls, uninsulated and insulated, are as follows, using the formula—[Area x (U) x (average difference in temperature inside and out) = B.t.u. heat loss per hour].

Uninsulated 2,280 x 0.27 x 30 = 18,468 B.t.u. per hr.
Insulated 2,280 x 0.062 x 30 = 4,241 B.t.u. per hr.

Heat Loss Through Roof Alone

Following the same procedure as for the side walls, the value of (U) for the roof, and the heat loss through the roof, uninsulated and insulated, is determined as follows:

	C	k	Uninsulated R	Insulated R
Conductance of outer surface	6.00		0.167	0.167
Rigid shingles	6.00		0.167	0.167
Wood sheathing	1.28		0.781	0.781
3⅝-in. air space	1.10		0.908	
3⅝-in. fill-type insulation		0.27		13.420
Plaster on wood lath	2.50		0.400	0.400
Conductance of inner surfaces	1.65		0.606	0.606
Over-all resistance (R)			3.029	15.541
Heat transfer coefficient (U), which equals $\frac{1}{R}$			0.33	0.064

Total roof area to be insulated, 1,202 sq. ft.

Heat Loss Through Roof:
Uninsulated 1,202 x 0.33 x 30 = 11,900 B.t.u. per hr.
Insulated 1,202 x 0.064 x 30 = 2,308 B.t.u. per hr.

Total Heat Loss, Walls and Roof

From the above, the total heat losses through the walls and roof, uninsulated and insulated, are as follows:

	Uninsulated	Insulated
Walls	18,468	4,241
Roof	11,900	2,308
Total loss, walls and roof	30,368	6,549 B.t.u. per hr.

Saving in heat loss through use of insulation—23,819 B.t.u. per hr.

heating season involving 3,570 hours, as assumed in the foregoing, we have

$$\frac{23{,}819. \times 3{,}570}{14{,}000{,}000} = 6.08 \text{ tons per year}$$

saving in fuel. Knowing the cost to install the insulation in the building in question, and the cost of fuel per ton delivered, it is then a matter of simple arithmetic to establish the annual return on the investment in insulation from the standpoint of fuel economy alone.

Heating Plant and Radiation

Following a somewhat different but no more difficult procedure, having already calculated the heat losses of a building, uninsulated and insulated, it is a simple matter to determine the saving in radiation resulting from the use of insulation, an amount which, converted into dollars, should be deducted from the cost of the insulation. Similarly, if a more economical heating plant is made possible, this saving should also be credited to the cost of the insulation.

Space does not permit the presentation within this report of all of the data required to calculate the possible savings in fuel, radiation and heating plant costs through the use of insulation, but the committee emphasizes the fact that these data are readily available and should be employed more widely by the railways in determining the extent to which they can make use of insulation to advantage, and under what conditions they can secure the largest return.

To any direct economic saving through the use of thermal insulation, the committee recommends be added the intangible advantages that often accrue through increased employee comfort, efficiency and even health in some cases. Many roads that have employed insulation have cited these factors as of importance, and even roads that have made little or no use of insulation point to these factors as worthy of careful consideration.

More Study Recommended

The committee, along with the majority of those collaborating in its report, believes that there is a wide field for the effective use of insulation in railway buildings, in both new construction and in existing structures. It fully recognized the limitations of its use, however, in certain types of railway structures under favorable climatic conditions, and recommends, therefore, that the question of the use of insulation in any particular building be based on a careful study of all of the advantages to be derived, both tangible and intangible.

Increased consideration should be given by the more northerly roads to the economies possible through the use of insulation. Similarly, southern roads, admittedly without the same possibilities for economy through fuel savings, might well investigate further savings possible through capitalizing on the structural value of insulating materials in certain forms available, and the increased employee comfort and efficiency which are likely to result. The committee cautions, however, against the use of insulation in extremely warm climates, unless in conjunction with some air cooling or conditioning system, to avoid the possible creation of a condition where the insulation will function as a heat retainer, keeping a building uncomfortably warm once it has become thoroughly heated. Obviously, special study should be made, both in the north and in the south, of the economic advantages of insulation in connection with any installation of air-cooling or air-conditioning.

Insulating This Scale House on the B. & L. E. Proved Highly Effective and Economical

Other Recommendations

The committee makes no recommendation concerning the type or form of insulating material to be employed, but points out that in addition to the quality of resistance to heat transfer, the qualities of resistance to vermin, rodents and deterioration are all important. Likewise, under practically all conditions, resistance to fire and moisture are also highly important.

The amount of thickness of the insulation installed in any part of a building requires as careful consideration as whether the building should be insulated at all, it being a known fact that beyond a certain thickness, depending upon conditions, the economic value of any additional material decreases rapidly.

The application of insulating material should be strictly in accordance with the specifications of the manufacturer in order to gain the maximum efficiency, unless altered on the side of safety to secure increased fire stoppage value, increased protection against abuse or deterioration, and the minimum possibility of moisture condensation within the walls or ceilings of buildings.

The committee cautions particularly against the possibility of wall and ceiling insulation causing excessive condensation within the walls or above the ceilings of heated buildings, especially where the humidity within the building is likely to be high. To avoid or to minimize the possibility of such condensation, it recommends the use of an effective vapor barrier, such as heavy, asphalt-impregnated and surface-coated sheathing paper, as close to the inside faces of the walls and ceiling as possible, and that some attic ventilation be provided.

The use of insulation should be no substitute for sound, tight building construction. It is true that many types of insulation add materially to the weathertightness of a poorly constructed building, but in the interest of economy in building maintenance costs generally, and in the use of fuel, sound, tight construction should be employed, regardless of whether insulation is used.

With a large percentage of the heat loss from buildings through and about windows and doors, careful consideration should be given also to the value of weatherstripping, calking, storm sash and double glazing. A study of the relative values of these additional means of making buildings weathertight, in the interest of economy and improved employee and patron comfort, might well form the basis of further committee study.

Committee—N. D. Howard (chairman), managing editor, *Railway Engineering and Maintenance*, Chicago; B. W. Guppy, engineer of structures, B. & M., Boston, Mass.; F. H. Lehrman, bridge draftsman, C. & N. W., Chicago; J. H. McClure, bridge and

building master, C.N., Moncton, N. B.; T. D. McMahon, architect, G. N., St. Paul, Minn.; E. C. Neville, bridge and building master, C. N., Toronto, Ont.; N. F. Podas, district engineer, Minnesota Transfer Railway, St. Paul, Minn.; E. L. Rankin, architect, G.C. & S.F., Galveston, Tex.; and T. H. Strate, division engineer, C.M.St.P. & P., Chicago.

Discussion

L. A. Cowsert (B. & O.) described the difference in comfort between an insulated building and one having no insulation. Then, answering a question from the floor, Chairman Howard said that the committee did not attempt to go into the cost of insulation and of its installation, because of the many different kinds on the market and the variable installation costs. He pointed out on behalf of the committee that it was its primary purpose to bring out the savings in fuel that can be made through the application of insulation and to demonstrate how readily this can be figured for any particular structure. Continuing the discussion, several interesting examples of the effectiveness of building insulation were pointed out, including the insulation of the fourth-story ceiling of a large hospital building, and the walls and ceiling of a scale house.

Closing the discussion, L. H. Lafolley (C.P.R.) brought out the importance of that section of the report referring to methods other than insulation for minimizing heat losses from buildings. He emphasized that in connection with insulation, careful consideration should also be given to the value of weatherstripping, calking, storm sash and double glazing.

The Maintenance of Cinder Pits

Report of Committee

C. A. J. Richards
Chairman

YOUR committee secured information from 25 railroads of the United States and Canada. In the study of their practices it was thought advisable to review not only the maintenance of cinder pits but construction and operation as well, as it was felt that much maintenance is due to faulty design or poor construction.

Most railroads still have the depressed loading tracks at the older and generally smaller layouts. Mechanical handling plants of the hopper and skip type, loading directly into cars are quite popular and are gradually replacing the depressed loading tracks. Water-type pits meet with the approval of some railroads while they are not favored by others.

Depressed-Track Type

The length of pit varies from 25 to 50 ft., depending on whether one or two of the smaller engines are serviced at one time. These pits generally have the floor paved with brick or concrete, but practically no protection is provided for the intermediate supports, beams or sidewalls. Cast iron pedestals are generally used to support beams carrying the running rails but occasionally brick or concrete piers support inverted rails.

Cinders are dumped on the floor and are then either shoveled by hand into a cinder car, or a crane is used. Most of the railroads that replied to the questionnaire advised that they still have some pits of this type.

Water-Type Pits

This type of pit varies from 18 ft. to 164 ft. in length and from 4 ft. to 13 ft. in depth, the larger ones being able to service two large engines on a track at the same time. Water-type pits are generally built wide enough for two tracks, with a considerable opening between tracks so that a clam shell may be lowered between them to remove the cinders. This clam may be operated by either an overhead electric crane or a locomotive crane.

Generally old rails are imbedded in the concrete in the bottom of the pit to afford protection against the clam shell bucket striking the bottom continually.

A few roads either have in use, or are considering the use of fire brick to protect the beams or girders carrying the running rail from the heat of hot cinders lying against them. One railroad reported having a pit of this type with a solid limestone floor, having chosen a site for the construction of the pit where rock was close to the surface of the ground.

The principal objection to the water-type pit seems to be danger of workmen and others walking into the open pit and drowning, especially in the deep type. The use of railing at the ends of the pit as a protection against such accidents is quite general. A few railroads place wooden or metal gratings over the pits and the inter-track space, which gratings can be removed to permit the clam shell to remove the cinders.

The water-type pit is recommended by some railroads for large terminals, some preferring the pits 5 ft. to 6 ft. deep, and others, pits 10 ft. to 13 ft. deep. Other railroads see no advantages for this type of pit.

Skip-Hoist Type

There are a number of types of cinder conveyors which are practically all patented and are purchased from the manufacturers. The majority in use load direct into cars, but a few load into storage bins from which the cinders are run by gravity into cars.

The buckets are generally of one, two, or three cubic yards capacity and are electrically operated. Occasionally they are operated by air, especially at small layouts where the engine being serviced furnishes the air for cinder hoist.

This skip-type cinder hoist is being used at both large terminals and at smaller outlying points, replacing the older layouts with their depressed tracks.

One southern railroad reports using four installations of this type in a large terminal so arranged that four engines can be serviced at one time

and cinders dumped into two cars on an inside track. Another railroad reports excessive maintenance on buckets is being overcome by the use of copper-bearing steel.

In the conveyor type installation, it is necessary to use considerable water before the cinders are loaded into cars and in cold weather an accumulation of ice around the pits causes interference with operations unless the ice is removed promptly as it accumulates.

Maintenance

The greatest maintenance expense arises in connection with renewal of the beams supporting the track, and the renewal of the concrete supports for these beams because of hot cinders being allowed to accumulate. Considerable trouble of this character may be avoided by removing the cinders promptly in dry pits or by keeping the water at the proper height in wet pits.

The floors of dry pits are also damaged readily if hot cinders are allowed to lie on them for a great length of time; both brick and concrete are damaged by spalling or the floor becoming uneven.

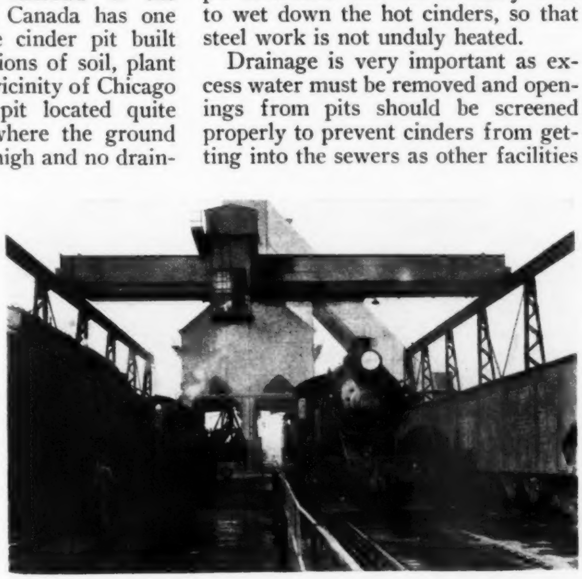
Probably every railroad in the United States and Canada has one or more homemade cinder pit built to meet local conditions of soil, plant layout, etc. In the vicinity of Chicago there is a cinder pit located quite close to the lake where the ground water level is quite high and no drainage is available. A couple of bridge girders were placed on timber mud sills, no bottom being provided originally although a concrete floor was added later. Rivets were removed from the top flanges of the girders and the running rails were bolted directly to them. Cinders are removed with a crane and a clam shell bucket, all intermediate top bracing and cross frames having been removed.

Rail may be fastened in a number of ways. Where the running rails are supported on steel beams or girders, the rails may be attached with bolts and standard clips. Where the rails rest on concrete copings, cinch anchors or expansion bolts are generally used.

The Dry-Type Cinder Pit, Equipped with Track Hopper and Skip Hoist, Has Become Increasingly Popular with Many Roads

The water supply must be adequate to keep the pits filled to the proper depth or to keep the hot cinders continually wet down. Sometimes a sprinkling system is provided which can be controlled by merely opening a valve. At other places the cinder pit attendant uses an ordinary hose to wet down the hot cinders, so that steel work is not unduly heated.

Drainage is very important as excess water must be removed and openings from pits should be screened properly to prevent cinders from getting into the sewers as other facilities are generally on the same drainage system.



A Double-Track Water-Type Cinder Pit Served By a Gantry Crane

Hot cinders should be wet down at all times or removed promptly from around exposed steel work. This is not always done, as at unimportant terminals where the cinder pits may only have occasional service from a hostler or part of a section gang. Likewise at busy terminals cinders may accumulate at certain hours, as inbound engines often arrive in groups, especially in the early morning after night runs are in. At these points, cinders are allowed to accumulate until later in the day and if they pile up too much, the steel beams become overheated and are burned and warped, and renewal of the beams becomes necessary after a year or two of this type of daily abuse.

Cost

One middle western railroad reports the following cost per ton of handling cinders and of maintenance of various types of pits:

Deep Pits	Cost per ton Handled	Maintenance Per Ton	Total
Over Head Crane	10c	6c	*16c
Clam Shell Crane	19c	16c	35c
Skip Hoist	11c	2c	13c
Depressed Pits	17c	1½c	18½c

*Included maintenance of crane.

A western road which removes cinders from a pit and stores them until ready to ship a car for use some place, reports the following cost per ton of handling.

Cleaning pit and storing	$0.07
Loading on car	0.035
Total	0.105

Another western road reports the following cost per ton for handling cinders and maintenance of pits.

Type of pit	Handling Cinders	Maintenance	Total
Conveyor	$0.079	$0.023	$0.102
Deep Water	$0.029	$0.059	$0.088
Dry	$0.158	$0.002	$0.160

From the replies received, the recommendations for cinder pits at large terminals were for either the dry mechanical handling pit or the water-type pit.

Committee—C. A. J. Richards (chairman), mast. carp., Penna., Chicago; J. G. Sheldrick (vice-chairman), res. engr., Soo Line, Minneapolis, Minn.; E. E. Fobes, asst. supv. b. & b., N. Y. C., Albany, N. Y.; G. H. Holmes, supv. b. & b., M. P., Fall City, Neb.; A. C. Irwin, ry. engr., Portland Cement Ass'n, Chicago; W. G. Kem-

merer, asst. engr., Penna., Chicago; F. Misch, bridge inspector, S. P., Bakersfield, Cal.; J. H. Phillips, bridge & building master, D. & H., Watervliet, N. Y.; James Pullar, assistant engineer, C. N., Moncton, New Brunswick; W. J. Strout, superintendent bridge & building, B. & A., Houlton, Me.; M. P. Walden, assistant supervisor bridges & buildings, Louisville & Nashville, Evansville Ind.

Discussion

The discussion of this report centered largely around the type of cinder pits in service and the question of disposing of cinders during extremely cold weather. G. S. Crites (B. & O.) described a type of pit installed some years ago by the Buffalo, Rochester & Pittsburgh. These pits are somewhat like inspection pits but are filled with interlocking buckets into which the cinders are dumped. When filled, a gantry crane picks the buckets up and dumps them into cinder cars. Very little water is needed to keep the fire down and this type of pit, which contains about 20 buckets, requires little maintenance. A. C. Irwin (P.C.A.) stated that there is a similar pit at Western avenue on the C.B. & Q. W. H. Walden (Southern) described a similar pit on his road, the buckets of which had been constructed entirely of second-hand material.

It was the consensus of opinion that where water-quenching pits are in service it is desirable to unload the cars containing cinders removed from such pits as quickly as possible on storage piles close to the engine terminal, for the purpose of avoiding the freezing of the wet cinders during the winter season.

Pipe Lines for Railway Water Service

Report of Committee

IN preparing this report, your committee noted that comprehensive reports have been presented on this subject previously. For this reason this report is concerned only with developments in pipe line construction and maintenance in the last 20 years.

When considering first the laying of a pipe line, it must be recognized that every project is different and due allowance must be made for the various factors entering into this work. Among the factors to be considered are:

A—Service

(1) Lines subject to low pressures, such as for filling a tank or reservoir, or serving as equalizer lines between tanks.

(2) Lines subject to normal pressures with occasional high emergency pressures, such as general service lines connected to city supply where pressures are increased in case of fire.

(3) Lines subject to high pressures and water hammer, such as those serving water columns, etc.

(4) Possible future requirements of the pipe line as to increased quantity, increased pressure, etc.

B—Location

(1) If line is to be above ground, it may be exposed to corrosive gases or aggressive spray, etc.

(2) If to be underground, a thorough investigation of the soil and ground waters should be made to determine their aggressiveness. In aggressive soils, cinders, etc., the backfilling should be of less corrosive quality such as clay. Highly aggressive soils may warrant the additional expense of a protective coating on the pipe.

(3) Type of water to be carried in the pipe. As a rule, hard waters are non-corrosive but may cause incrustation. Soft waters are more corrosive and consideration should be given to the necessity of a lining.

R. E. Dove
Chairman

(4) Will pipe line be subject to vibration and if so, to what extent? Will rigid leaded joints, etc., be broken, permitting leakage?

(5) Presence of electrical facilities which might cause electrolysis.

(6) Difficulty and cost of making repairs after pipe line is installed.

C—Costs

(1) Initial costs of different types of pipe and joints, plus transportation to site of work.

(2) Labor costs for installation.

(3) Equipment available and that necessary for installation.

(4) Possible loss in the use of facilities and also the loss by fire in the event of a line failure.

(5) Cost of operation due to friction losses.

(6) Expectant life to determine annual cost.

There are a number of kinds of pipe materials to select from, including wood, cast iron, wrought iron, steel, asbestos-cement, copper, brass and lead, briefly described as follows.

Wood pipe of the stave type is still in use, particularly along the Pacific Coast, for low-pressure lines. There are several varieties of cast iron pipe; namely, bell and spigot, flanged ends, male and female and centrifugally cast. The bell and spigot and the flanged end types are well known and in general use. The male and female is made in the smaller diameters, is quite flexible and is suited particularly for underground use. The centrifugally cast pipe has greater tensile strength than the pit cast iron and has more corrosive resistance. This last named type, manufactured in this country only since 1922, is becoming quite popular.

Wrought Iron Pipe

Genuine wrought iron pipe is generally esteemed for its resistance to atmospheric corrosion and, due to its fatigue resistance, is used for pipe lines subject to shock and vibration. The metal includes about three per cent of slag and it is claimed that this slag helps produce a dense film over the surface and thus protects the underlying metal from corrosion. Steel pipe has great strength and ductility and, for this reason, it will withstand high internal and external stresses brought on by bending and deflection. It is particularly advantageous in withstanding water hammer, emergency high pressures, sudden shock, cave-ins, settlement or insecure foundations. It is made by two processes, seamless and welded.

Spirally welded pipe is made either from iron or from steel coiled strips which are wound by machines into a

continuous spiral tube and the edges fused together by electric arc welding. The weld strength is greater than the metal of the pipe. One of the advantages of this pipe is that it can be obtained with one or more fittings welded on to a length, if desired, thus eliminating weight and possible points of leakage. Properly coated and installed, steel pipe will give many years of useful service underground.

Asbestos-Cement Pipe

Asbestos-cement pipe is relatively a newcomer in the pipe field. As its name implies, it is manufactured from a mixture of asbestos fiber and cement, which are fire-resisting and corrosion-resisting materials. The pipe lengths are joined together with Simplex couplings made of the same material as the pipe but of larger diameter. All abrupt changes in direction must be made with the use of cast iron fittings having all bell ends large enough to permit making a calked joint. Connections to this pipe are made by ¾-in. corporation cocks and, if a service connection of greater area than ¾ in. is desired, it must be made by a series of ¾-in. connections or else with the use of a saddle ring. For lines subject to tuberculation or electrolysis, this pipe should be given consideration.

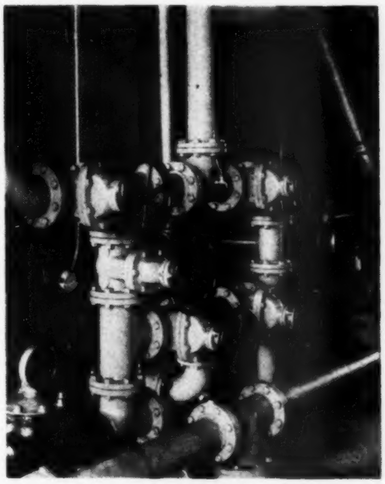
Copper pipe has not been used extensively in this country until rather recently, although it was used as early as 2700 B. C. by the Egyptian Pharaohs for piping water to their palaces. Its high ductility makes it adaptable for use where vibration is a factor. It has ample strength for most pipe line installations and is highly resistant to all types of corrosion, including electrolysis. Also the absence of rust accumulation eliminates the necessity for installing oversize pipes, as frequently is done with ferrous pipe materials. It is suitable particularly for replacement work.

Joints and Couplings

For many years, joints were confined very largely to three types, namely, the bell and spigot as used with cast iron pipe, the "wipe," or soldered joint as used in lead and copper pipe, and the screw and joint as used with wrought iron and steel pipe.

Joints formed with a mortise and tenon were used in ancient times for connecting pipe made of stone, baked clay and wood. The poured lead bell and spigot joint has been in continuous use since 1785.

The soldered joint was probably first used with lead pipes in the Roman Empire about 300 B. C. This lead pipe was made from sheets bent around a mandrel and soldered to form the pipe, after which the end of one pipe was telescoped into another and soldered to form a continuous pipe. The threaded joint is about



A Wide Diversity of Pipe and Pipe Fittings Is Required at Practically Every Water Treating Plant

120 years old, having first been used in 1815 to connect old musket barrels for the purpose of conveying coal gas.

Many different types of pipe joints have been developed in recent years. In 1934, a committee of the A.R.E.A. listed 121 different pipe joints and this does not comprise all known joints. For this reason, it is impractical to discuss the relative advantages and disadvantages of each of the various types of joints.

The hub and spigot joint and also the threaded pipe joint are too well known to require any discussion. Flanged pipe or threaded pipe with flanges screwed on is generally used on inside work where a nice appearance and rigid pipe line are desired. When drawing up the bolts on the flanges, it is important that the tightening be done a little at a time on each bolt to avoid pinching the gasket and thus damaging it. For best results, the gasket should be of such diameter so as to lie entirely within the bolt circle, as a tighter joint can be obtained more easily. With the high pressure pipe line, the slightly raised faces of the flange accentuate the pressure on the gasket.

Special Joints

A type of joint that is coming into popular use is the expansion type of coupling which is ordinarily used with plain end, threaded or beveled pipe. This joint consists of a metal middle ring having an inside ridge in the center, to which the two lengths of pipe are pushed. The outer edges of the ring are flared and wedge-shaped rubber gaskets are fitted under these flares. Metal follower rings fit up against the gaskets and are bolted together. When the bolts are tightened, the gaskets are pressed tightly against the pipes and a pressure-tight joint is secured. These joints are flexible and the pipes pivot on the two gaskets. No caulking is necessary and the only tool that is required is a wrench, which means that no highly skilled labor is required. Another advantage is the fact that small changes in alinement may be made with the regular straight lengths of pipe by a small movement in the couplings.

In the small pipes, from ⅜ in. to 2 in. in diameter, a coupling of the same principle is available. It is applicable to threaded or plain end pipe and can serve the purpose of a union as well as a coupling. It has a middle ring with a projecting flange at each edge. These flanges are threaded on the outside and provide a recess underneath, in which armored rubber gaskets are retained. The follower rings in this case are hollow nuts which, when screwed up, compress the gaskets and make a joint suitable for water pressure of 150 lb. per. sq. in.

Simplex Couplings

Another joint, known as the doublex simplex, is made in a manner similar to packing a gland on a piston rod. A specially designed ring, or packing, is placed in a beveled recess in the end of the pipe and pulled up by a bolted ring, which compresses the packing, thus forming a tight joint. This joint permits a certain amount of deflection and expansion without leakage.

The simplex coupling mentioned with the asbestos-cement pipe is of two types, one of which is assembled in the field and the other is factory assembled. The factory-assembled coupling is installed on one end of the pipe at the plant where the pipe is made. It differs from the field-assembled coupling in that it is provided with less clearance between the pipe and the internal shoulders and is slightly longer than the one used in the field assembly. The coupling rings of both types are of molded rubber composition and are round in both form and cross section. The inside diameter of the rubber rings varies from 4 in. for the 4 in. pipe to 33 in. for the 36-in. pipe. When a joint for a pressure of more than

150 lb. per sq. in. is desired, it is recommended that the spaces at the sides of the joint collars be grouted with cement.

Corrosion and Electrolysis

Soil corrosion is a serious problem with ferrous pipe materials underground. The soils differ widely in their corrosiveness, as illustrated by the chart of the findings of the U. S. Bureau of Standards Soil Investigation. It is well known that the initial rate of corrosion of metal is high and that, as a rule, it decreases rapidly with age. Consequently, an increase in the thickness of the thinner-walled pipes, such as steel and wrought iron, will add materially to its life.

Internal corrosion of a pipe is due to the corrosive character of the water carried in it. As a rule, the soft waters found in some of the Eastern and Southern states are corrosive, whereas hard waters are not. There are very few cases on record where internal corrosion has penetrated a pipe from the inside. However, internal corrosion presents a problem in that rust tubercles form and reduce the effective opening. This is more serious in the smaller pipes for the reason that, while the build-up of these rust nodules in large pipes will reduce the size of the free opening, the same amount in a small pipe may completely block the opening.

Briefly, electrolysis is the conducting of electric currents by chemical solutions in water. Under ordinary conditions, soils contain considerable water with salts in solution, which makes them electrolytic conductors. When an electric current passes through soil, it does so by electrolytic conduction and by a corresponding chemical decomposition at the electrodes. Where an electric current leaves a metal pipe for the soil, it corrodes the metal by this action of electrolysis.

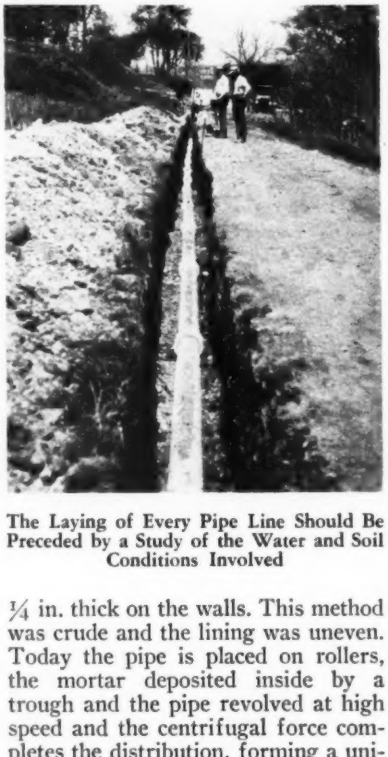
To protect pipes from corrosion, incrustation, etc., various coatings and linings are in use and fall into the following types — paints, metallic coatings, bituminous and cement coatings and linings.

The pipe manufacturer generally applies a light coating of coal tar pitch varnish or a primer coat of red oxide synthetic enamel to protect the pipe while in transit to the job. The synthetic enamel is applied where it is the intention of the purchaser to paint the line with an oil paint later.

In some cases, it has been found that bituminous coatings of low melting point are subject to soil stress, in that, when the soil shrinks through drying, it has a tendency to pull the coating away from the pipe. This can be overcome by placing some shielding material over the coating. One of the chief causes of coating failure is the mishandling of the pipe.

Linings

Cement-lined pipe did not have an important place in the pipe field until about 1922, at which time some tests were made in Charleston, S. C., to aid against tuberculation. During the early stages of producing this cement-lined pipe, it was done by placing cement mortar inside and pulling a bullet-shaped plug through it, thus depositing a layer of cement about



The Laying of Every Pipe Line Should Be Preceded by a Study of the Water and Soil Conditions Involved

¼ in. thick on the walls. This method was crude and the lining was uneven. Today the pipe is placed on rollers, the mortar deposited inside by a trough and the pipe revolved at high speed and the centrifugal force completes the distribution, forming a uniformly dense lining. These pipes retain their original carrying capacity. Generally speaking, the usual tar pitch varnish lining on metal pipes will protect pipe from tuberculation, except under extreme conditions where cement-lined pipe will be found effective.

Conclusions

As stated at the beginning of this report, each pipe line project must be studied from many angles to ascertain the pipe material and joints best suited, and it is not the intention of your committee to state any hard and fast rules for pipe materials to be used for pipe line construction.

It is difficult to obtain any cost data but the following general practice on one western railroad may be of benefit:

"Wood pipe to be used on gravity supply lines 2 in. to 10 in. in diameter on its West Coast end, where the pressure does not exceed 65 lb. per sq. in.

"Black wrought steel, ⅜ in. to 12 in. in diameter and random lengths, to be used on heating systems and for temporary supply lines." (This railroad does not encourage the use of this pipe on underground supply lines).

"Galvanized wrought steel pipe, ⅜ in. to 12 in. in diameter and random lengths for exterior piping, such as stockyards and for interior plumbing." (This railroad cautions its men not to use this pipe in corrosive soil and cinders).

"Cast iron pipe, including bell and spigot, flanged joints and centrifugally cast, sizes 3 in. to 14 in. in 16 and 18-ft. lengths, to be used on underground supply lines such as around treating plants, storage tanks, roundhouses, etc., and for use in lines of pressures up to 150 lb., in corrosive soils and cinders and for fire protection systems.

"Male and female cast iron pipe, sizes 1¼ to 3 in. and in 5, 10 and 15-ft. lengths, for use in underground supply lines to stockyards, etc., for low pressures up to 100 lb., in corrosive soils and cinders and for fire protection systems. Pipe to be furnished with thread protectors.

"Genuine wrought iron pipe, sizes ⅜ in. to 12 in. in diameter and random lengths, for permanent use on storage tanks, riser pipes and for interior piping exposed to corrosive gases. Pipes to be threaded and coupled with thread protectors or with flanged joints.

"Copper pipe, sizes ⅜ in. to 2½ in. Type "K" soft temper in 12 and 20-ft. lengths for use on underground supply lines to depots, stockyards, etc., for pressures up to and including 60 lb. and for corrosive soils and cinders."

Asbestos-cement pipe has been used on certain installations and has not presented any maintenance difficulties.

Coated wrought steel and coated spiral welded steel pipes are now being studied for consideration on underground installations.

Sleeve type couplings have been found to be considerably more economical than calked joints on pipe over eight inches in diameter.

The above practice has been arrived at after many installations and careful study and is the pattern that this western road encourages its men to follow when pipe jobs arise.

When pipe is to be laid in cinders or in soils known to be corrosive, it should be protected by heavy bitumastic coatings or other protective coatings. For extremely unfavorable soil conditions, the pipe should be wrapped in addition.

In conclusion, it is recommended that thoughtful consideration be given to the many phases of pipe line construction and the materials and especially to the characteristics of the soil and of the water to be carried.

Committee—R. E. Dove (chairman), asst. engr., C. M. St. P. & P., Chicago; B. R. Meyers (vice-chairman), asst. div. engr., C. & N. W., Sioux City, Iowa; U. S. Attix, gen. fire insp., S. P., San Francisco, Cal.; C. A. Bouton, asst. gen. fore., N. Y. C., Ravena, N. Y.; A. M. Glander, chf. carp., C. M. St. P. & P., Mason City, Iowa; C. R. Knowles, supt. water serv., I. C., Chicago; A. J. Reading, asst. engr., P. M., Detroit, Mich.; T. J. Sheehy, supv. water serv. & p., D. & H. Plattsburg, N. Y.; H. E. Thompson, b. & b. supv., D. & H., Oneonta, N. Y.; L. C. Winklehaus, asst. engr., Chicago & North Western, Chicago.

Discussion

G. S. Crites (B. & O.) started the discussion of this report by first telling of the severe internal corrosion of cast iron pipe which he had observed in certain sections of Pennsylvania, resulting from the handling of saline waters. He said that he had seen such pipe rust through in three to four years.

C. R. Knowles (I.C.) said that the failures in wood stave pipe were generally in the metal banding, but that if such pipe was not kept saturated, it would decay in time. In this regard, he pointed out that the thickness of wood pipe should be such that the wood shell will stay saturated.

In his remarks, Mr. Crites also called for increased consideration of the use of copper pipe in shops, engine houses and passenger stations where economically feasible, and suggested that further consideration should be given to the advantages of welded joints in wrought iron and steel pipe lines, and for carrying air as well as water and steam. He said that welded joints had proved highly economical and effective, and did away with the problem of leaks.

At this point, R. E. Coughlan (C. & N. W.) described the 6½-mi., 14-in. asbestos-cement pipe line which his road installed in 1936-37 to connect its extensive Proviso yard facilities with the city water supply of Chicago.

Continuing the discussion, A. L. McCloy (P.M.) called attention to a new development in the lining of wrought iron pipe with redwood, and E. H. Thwaits (Youngstown Sheet & Tube Company), commenting upon the exterior corrosion of pipe lines, spoke of the effectiveness of exterior coatings available, and of the importance of not damaging these coatings during the installation of the pipe.

On a question raised by Armstrong Chinn (Alton) concerning methods available for cleaning the interior of pipe lines to restore their capacity, Mr. Knowles said that patented cleaning devices are available to the railroads on a rental basis, and that for some classes of work chemicals can be used effectively. Continuing, he commented upon the corrosive effect of cinders on pipe lines, and methods of protection. For severe conditions, he recommended a bitumastic coating of the pipe, followed by a wrapping of burlap and a final coating of bitumastic. He also said that the lime treatment of trenches through cinders had been found effective, and that he had been using lime waste from water treating plants for this purpose.

Closing the discussion, F. A. Anderson (Youngstown Sheet & Tube Company) spoke briefly of methods of coating and lining steel pipe with bituminous materials.

Meeting Today's Demands With Cranes and Pile Drivers

Report of Committee

IN these days of such rapid changes in transportation, no one foresaw or even made an effort to predict the developments in maintenance of way and structures. The trend on most railroads in the last 20 to 25 years has been definitely toward the increased use of heavier locomotives to haul more tonnage at greater speeds. Passenger trains traveling at high speeds, and freight trains with their extremely heavy motive power are placing more severe burdens on the track and on bridge structures and causing greater damage than ever before.

This increase in loadings necessitated changing our structures which had been handled by light-weight cranes and the old wooden pile driver with the drop hammer and replacing them with substantially heavier structures which required heavier cranes and pile drivers of modern type to handle them. About 60 per cent of the total mileage of all bridges in this country consist of pile trestles. Also, a large number of steel and concrete structures require piles for permanent foundations, piers and bents.

O. W. Stephens
Chairman

In view of these conditions, and of the extent that work equipment, such as cranes and pile drivers, contributes to the reduction of maintenance expenses, it is imperative that every piece of work equipment be put to its widest possible application. To obtain information on the diversified uses of cranes and pile drivers, this committee has contacted some 45 railroads in different sections of the country.

The pile driver is of the first importance in bridge work. The majority are fitted only for driving piles, however, and where a machine of this type is required to do other work it ought to be equipped also to perform the duties of a derrick.

In the early days practically all of the pile driving was done with the old style wood pile driver, and the drop hammer, although obsolete in design, is still in service throughout

the country. With this type of equipment, work trains are required for all classes of pile construction, although a few drivers have been equipped with self-propelling machines.

Some years ago, single- and double-acting steam hammers were designed to replace the drop hammer, and it is now a known fact that a steam hammer will drive 50 per cent more piling in a given period of time than a drop hammer. Improvements in design have also covered such features as driving plates and hoods which cause less damage to piles, notwithstanding the driving part actually comes in closer contact with the pile than with the driving head and large wood cushion used necessarily under all drop hammer driving.

On a majority of the railroads, the old-fashioned drop hammer has been replaced by the steam pile hammer, while still using the same original machine, although in some cases the capacity of the steam boiler will not permit the use of a steam hammer. These machines, while obsolete in model and operation, perform the necessary duties and will continue to be used. Nevertheless, in comparing these older machines with modern pile drivers, it is apparent that the old type machines are limited to certain classes of work, while their speed of operation and efficiency, measured in man-hours of labor, cannot compare with machines of more modern designs.

The most economical investment is to have all pile drivers self-propelling, so that they can move under their own power from one structure to another if they are close together, and to the nearest switch to clear the main line. Until a few years ago, this type of equipment was used also for light switching of cars where necessary to handle materials, as well as for driving piles.

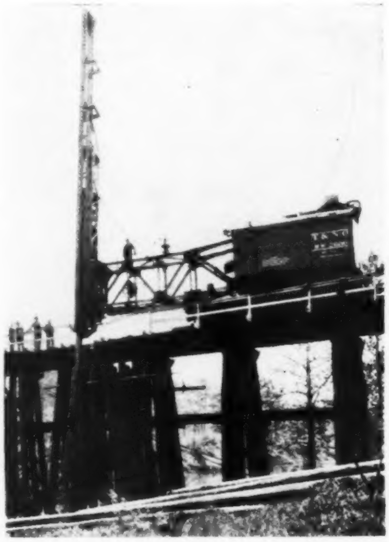
Modern track drivers should be full revolving, self-propelling at a speed of 15 to 20 m.p.h., and operated by either steam or Diesel engines. In case a Diesel engine is used, an auxiliary steam boiler must be provided to furnish steam for the operation of the steam pile hammer.

Steam is furnished by the burning of either coal or oil. With the oil-operated engine, a saving can be made not only in the fuel, but also by eliminating the fireman necessary on a coal-burning machine.

Pendulum pile leaders should be used in all cases so that the piles can be driven to their proper batter as shown on the standard plans. The modern self-propelled pile driver can be used to handle all material in pile trestle construction when the high cost of train service is not greatly involved, to place small size pipe culverts, etc.

The modern pile driver machine is best fitted for all general pile trestle work and in such emergencies as washouts, for it meets all the conditions of driving easier and quicker and with economy.

There are two types of pile drivers being used by the railroads, the mast type and the locomotive crane with leaders. On those railroads that have a large number of timber trestles to maintain or have sufficient pile driving work of all kinds to keep a machine busy nearly all year, the mast type driver is preferred.



This Mast-Type Pile Driver, Full-Revolving and Self-Propelling, is Designed Exclusively for Pile-Driving Work

Since the use of the mast type pile driver is limited to the driving of piles or the direct lifting of material under the leads, there are still a few railroads that have auxiliary booms or drop-line booms which replace the pile-driving mast, making the machine serviceable for other types of work. One of the accompanying illustrations shows a mast-type pile driver in operation, this machine being designed exclusively for pile-driving work, being full-revolving and self-propelling.

On the locomotive cranes to which swinging leaders and steam hammers can be attached, the leads are fastened rigidly to the bottom of the boom, allowing for more accurate pile driving. As a rule, equipment of this type requires considerable time to erect at the job, as the occasions are rare when a crane can travel to the siding for storage overnight without removing the leads and hammer in order to lower the boom to meet overhead clearances.

Convertible Machines

Another type of machine used on several of the railroads is the convertible pile driver and crane. This machine has folding pile-driving leaders and platform, which not only holds the leaders rigid to the frame of the revolving machine, but the leaders should be of the pendulum design for driving batter piles, a very important feature in trestle structure. Also, longer piles can be driven with a long boom than usually can be driven with a mast type of driver, while it is a fact that the leaders with the hammer and platform take a position parallel with the boom, allowing the boom to be lowered when required. This takes only a short time to manipulate. The capacity of this type of machine ranges from 30 to 45 tons and it is equipped with a long boom.

While a machine of this type may be used to perform both classes of work, in emergencies such as washouts or wrecks it can be used for only pile-driving or for derrick work. Particularly in washouts it is urgent to use both types of machines to expedite the opening of the line, and if the convertible machine is the only one available, the pile driving is going to be delayed where it is necessary to use the machine as a driver, or the removal of debris or structures will be delayed where a derrick must be used.

A good example of the adaptability of this type of crane happened recently on an eastern road. The crane was being used to drive piles on a repair job when a washout and landslide occurred at another location some 70 miles away. It was possible to send the equipment and men to the troubled area in a short time, and use the clam shell to remove the debris from the tracks and also unload cinders and other materials to fill in the area washed out.

This machine can be assembled quickly as a crane for setting steel spans of moderate lengths; it has enough boom length to drive piling in the wings of abutment foundations with a swinging hammer, and it has enough reach to drive steel sheet piling for docks. Also, it can be equipped with a clam shell or orange peel bucket or with an electric generator to operate a lifting magnet or electric tools, and furnish lights for night work.

A specially-constructed conver-

tible crane and pile driver is being used to advantage on the Delaware & Hudson. This machine differs from the regular type in that the boiler is carried on a separate car, which allows the crane to have a short tail swing for driving piles or other work in restricted spaces, such as the driving of piles inside bridges or without interfering with traffic on an adjoining track, the only disadvantage being that this machine cannot work through 360 deg. because of the trailer car, unless the steam is transmitted through a long hose. This machine carries the latest type folding leads and platform which can be installed or removed in a very short time. It is equipped with a clam shell and magnet; it is also equipped with a special swivel joint which makes it possible to take in steam through a connection at the end of the car body, similar to an air brake, and pipe it through the swivel joint to the upper deck of the crane where it connects with the hose leading to the steam hammer.

Another important piece of equipment for handling all types of structures is a steam- or oil-operated self-propelled crane with a 40-ft. boom and removable sections 10 to 20 ft. long to make the boom longer when needed. These cranes usually range from 25 to 60 tons in capacity at a minimum radius so that they can be used for all classes of erection and other work. These machines should be equipped for operating clam shell and orange peel buckets, magnets, etc. All cranes should be equipped with suitable outriggers for blocking the car body to prevent the danger of their tipping when handling exceptionally heavy loads.

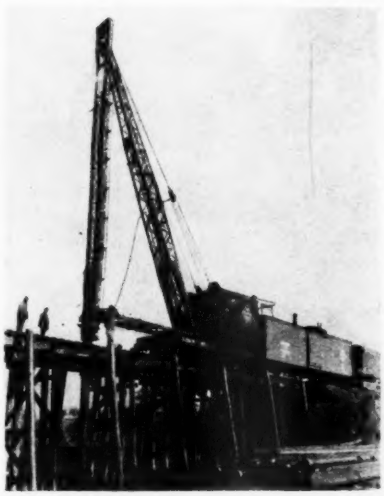
Wrecking Cranes

The wrecking cranes that are used generally on all railroads vary in capacity from 60 to 200 tons. These cranes are stationed conveniently at division points from which they are shipped out to clean up wrecks; they are used also to assist in the erection of steel and concrete bridge structures where the work is done by company forces. Nevertheless, these cranes are also loaned to the contractors who do railroad work.

Large cranes can be used for unloading heavy riprap, and other heavy material, including rails, timbers and steel spans. They are also of great help in the restoration of the washed out roadbed and structures and the removal of the debris that may have accumulated.

For light work only, a small full-revolving self-propelled crane of the type usually used in laying rail in track, is also a very efficient unit of equipment for handling such bridge material as timber in pile trestles and cofferdams, removing old masonry, excavating with clam shell or orange peel buckets, placing pipe culverts, backfilling and similar work. In changing out the decks on pile trestle bridges, this type of machine can be used to good advantage by first placing all new stringers on the ground opposite each panel where ground conditions will permit and the old stringers when released on the ground on the other side. Also the placing of the caps and stringers can be done quicker, thereby increasing the number of panels rebuilt per day.

In making heavy winter repairs to the superstructures of timber coal and ore docks, the small full-revolving gasoline-driven crane has been of exceptional value in keeping the crews supplied with material and placing the heavy timbers. On jobs of considerable magnitude, one crane is required in the material yard and two on the deck to handle cars, unload materials and place the timbers.



The Locomotive Crane, Equipped with Pile-Driver Leads and Steam Hammer, Has Been Found Highly Adapted to Many Classes of Bridge Work

Auto Cranes

Much study has been given to small off-track hand and power derricks for handling materials in the construction of trestles, decks on steel bridges, etc. Machines with crawler mountings, including draglines, tractors and cranes, are being used quite extensively with economy in maintenance work.

Several roads have adopted the use of auto cranes in the bridge and building department for handling lumber and other material and for placing stringers, girders, etc., in connection with overhead bridges in locations where the traffic is congested. Instances are known of auto cranes setting bridge girders in place on overhead bridges long before it would have been possible to construct temporary tracks to carry a locomotive crane. Machines of this type are advantageous in locations where traffic is congested, and also where flexibility in movement from place to place, speed of travel, adaptability for diversified uses such as excavation, installing water lines, culverts and drains are important considerations.

Crawler-Mounted Equipment

Prior to the depression, there was considerable activity among most of the major railroads in this country in the purchase of crawler-mounted cranes, shovels and draglines for their maintenance of way work. This activity was very rapid when the railroads realized the advantages of the crawler-mounted machine as opposed to equipment mounted on railroad wheels. Crawler equipment can be moved off a car and work on the right of way without tieing up active tracks, except in driving piles, where steam must be furnished. A crawler crane of 10 tons rated capacity can often replace a locomotive crane of 20 to 30 tons capacity, because the more mobile crawler unit can get closer to the work to be done and operate at a shorter radius than the locomotive crane which is confined to the track.

Various railroads throughout the country have crawler equipment which can be converted from a shovel to a crane or drag line, and which are used for almost every imaginable type of work, their high speed and easy mobility making them exceptionally valuable. They are used for digging and cleaning ditches, loading and unloading coal and cinders, etc., setting signal towers, bridge and building work and many other types of work. They are used a small portion of the time inside of gondolas and the balance of the time are doing off-track work. Some of the western railroads use them for ditching from the top of a flat car, as well as for ditching from the ground. Where these machines are shifted from place to place occasionally, the railroads usually build special cars for transporting them, with ramps so they can be

loaded and unloaded quickly. They are used for cleaning rock slides and with crane booms are used extensively for bridge work, as well as pile driving with drop hammer or steam hammer.

Dock Cranes

Certain types of crawler cranes are used by railroads that have dock or harbor facilities. These cranes are equipped with magnets for handling ore from the boats to cars. Others have clam shells for handling coal; then others use the ordinary load line for loading or unloading straight cargo.

While these crawler machines were not purchased for bridge and building work, nevertheless it is possible to use them to good advantage at times when water facilities are not active. In one particular case, a crawler gasoline crane was used solely in the erection of a 1,200-ft. timber overflow trestle. This crane unloaded all material at the beginning of the proposed trestle; it also handled the pile driving by means of a steam hammer and leads, the steam being furnished from a locomotive stationed at the start of the trestle and transmitted to the crane through pipe and steam hose. This same crane distributed and helped erect all bents, and placed all stringers and ties for the entire distance of the trestle. On this particular trestle the crawler crane was far superior to the locomotive crane in that the machine could carry out the construction work without the necessity of building track for the erection crane.

While cranes and pile drivers for railroad use will no doubt continue to be chiefly the "on track" variety, the gasoline or Diesel crawler-type cranes will be used quite extensively in bridge and building work, building overhead highway bridges, driving piling, ditching, cleaning out under bridges, trenching for and laying pipe, backfilling and handling material of various kinds for all departments.

Care of Large Importance

The railroads have millions of dollars invested in crane equipment of all types today. A large amount of the steam equipment is obsolete; yet with no company building it except on special orders, which, of course, means very high prices, the only thing left to do is to use the old steam machines. The care of this equipment is of great importance in order that it will be in good condition when needed. Much of the responsibility for keeping the machines in condition lies with the operator in charge, but during the season when the crane or pile driver is not in use it should be carefully inspected and given the necessary repairs.

Maintenance costs for crane equipment will sometimes run rather high, but good supervision, talks with foremen and operators occasionally to see that they take the proper care of this equipment, will reduce some of these costs.

Thousands of dollars worth of equipment is put away until the next time it is to be used and its life depends on how this is done so that the company will be repaid for the sum it laid out in its purchase. It pays to take care of all equipment during the time it is not in use, to have a suitable storage yard and equipment shop for such parts as must be left outside, and to protect bright and movable parts against rust and theft of brass boiler fittings. Painting the steel and wood protection is a cheap and effective form of insurance. None of these protective measures cost much money; no elaborate yards or sheds are necessary, but they may mean the difference between useless junk and usable equipment when the time comes again for its use.

Committee—O. W. Stephens (chairman), trk. supvr., D. & H., Oneonta, N. Y.; F. H. Cramer (vice-chairman), asst. bridge engr., C. B. & Q., Chicago; C. W. Boyce, supv. b. & b., Y. & M. V., Vicksburg, Miss.; V. S. Brokaw, asst. engr., C. M. St. P. & P., Chicago; J. A. Doyle, b. & b. mast., D. & H., Oneonta, N. Y.; J. S. Hancock, bridge engr., D. T. & I., Dearborn, Mich.; C. S. Heritage, bridge engr., K. C. S., Kansas City, Mo.; C. T. Kaier, gen. bridge insp., D. L. & W., Hoboken, N. J.; L. R. Lamport, supv. work equip., C. & N. W., Chicago; W. J. Martindale, bridge fore., T. H. & B., Hamilton, Ont.; C. U. Smith, gen. mgr. & chf. engr., Board of Harbor Comms., Milwaukee, Wis.; J. J. Wishart, supv. b. & b., New Haven, Boston, Mass.

Discussion

From the discussion, it appeared to be the consensus that the regular mast-type pile driver is the most effective and desirable for most classes of straight trestle work, and is to be recommended for use by those roads which have enough pile-driving work to keep the equipment busy most of the year. However, many of the members pointed out the greater versatility of the locomotive crane equipped with pile-driver leads and with hoisting and excavating attachments, and there was general acceptance of the fact that this type of equipment is better suited for use by those roads with insufficient work to keep a machine busy constantly in pile-driving operations. One of the disadvantages in connection with the combination crane and pile driver, pointed out, is the greater amount of time required, in most instances, to lower and raise the leads, as compared with the standard pile driver. Another, he said, is the considerable time required in converting the crane for pile-driving operations and vice-versa.

Discussing the difficulties encountered in driving long piles with leads of insufficient length, J. B. Hunley (C.C.C. & St. L.) said that he had found an effective arrangement in the hitching of the crane boom to the pile driving leads, several feet down from the top of the leads. G. W. Rear (S.P.) said that he was employing short leads in many cases when handling piles of excessive length, letting the leads follow the boom down as the piles are driven.

At another point in the discussion, Mr. Rear emphasized the increasing use which is being made of both cranes and pile drivers with crawler-type and auto-type mounting. He cited several examples, pointing to the advantages of this type of equipment through minimized interference with train operation and the elimination of work train expense. From Mr. Rear's comments, and those of others, it was evident that many roads are turning to off-track equipment to avoid the high labor cost and traffic interferences involved in work train operation.

At another point in the discussion, the most effective type and weight of hammer for different classes of driving was considered. It appeared that many roads find the No. 1 Vulcan hammer adapted to many classes of driving, but instances were pointed out of roads finding it necessary to use more powerful hammers where especially difficult soil conditions are encountered.

Toward the close of the discussion, a number of members emphasized the importance of maintaining cranes and pile drivers to a high standard, both to permit their most efficient operation and to assure that they are available for use in cases of emergency. It was the consensus that where repairs to this equipment are made by the mechanical department, the most satisfactory work is obtained when the operators in charge of the equipment accompany it into the shop, advise those who are to make the repairs just what is needed, and stay with it until all repairs are made.

Safety in These Days of Reduced Forces

BY JOHN E. LONG

Superintendent of Safety,
Delaware & Hudson

SUPERVISORS are the key men in securing the co-operation among employees, which is necessary not only for the prevention of accidents, but for general efficiency in operation as well. The supervisor is responsible for the co-ordination of the work of those under him with the work of those in other departments. He should, under ordinary conditions, be a man possessing the qualities of leadership and executive ability. He should be able to give instructions in a way that commands not only respect, but confidence, good will and a willingness to comply. The supervisor should remember that, in the eyes of the men under him, he is the company. Men appointed to supervisory positions should fully realize their responsibilities, not only in quantity and quality production, but also in economical and safe production. He should have the ability to detect unsafe practices and correct them before accidents happen. Just because an operation has been performed many times without an accident, does not imply that the method used is safe. Many accidents are caused by following presumably safe practices which are actually unsafe, but the hazards of which have not been detected.

Watch Minor Injuries

When a severe injury or a fatality occurs in any department, the heads of that department are always keen to do something drastic about accident prevention to avoid a recurrence. However, when a comparatively minor injury occurs, the fact is often overlooked that the seriousness of the results has nothing whatever to do with its cause, and, therefore, with its prevention. In other words, the serious injury and the minor injury are usually the result of exactly the same cause, and both are important as an indication of the effectiveness of your accident prevention program.

After all, just what is an accident? Is it not something that happened when you did not think it was going to happen? An accident is really a mistake coming to light, and an injury is the result of an accident. Accidents do not always injure people. Statistics show that there are about 30 accidents to equipment or material to every 1 that even slightly injures a human being, and that there are an average of about 300 minor injuries to 1 lost-time injury. Strange things happen—a man may fall 30 feet and escape with a few bruises—another man may slip on a grease spot or trip over a water hose and fracture an arm or a leg. This shows us that, after the accident happens, you cannot control the severity of the injury. To prevent injuries, we must prevent accidents, and the group that practices continuous safety work the year around, directed at minor accidents that occur with more or less frequency, automatically prevents most serious and fatal injuries.

John E. Long

Must Set Example

A supervisor must show by his attitude and actions that he is 100 per cent for safety. This is very important. Can you reasonably expect a man working for you to carry out safety instructions if you do not demonstrate by your own actions that these instructions are not only practical but important? The men working for you are more apt to do what you do than what you tell them to do. Safety committeemen, properly guided by a supervisor, can be of considerable help to him in setting up a proper organization to prevent accidents to the men under his supervision. After all, successful accident prevention is largely a question of proper organization. Supervisors know that, if accidents happen to their men, they are held responsible. On the other hand, if the men under them work without accidents, they receive the credit for the performance.

Safety Rules

On our railroad we do not have printed safety rules. Without entering into any discussion as to the advantages or disadvantages of printed safety rules, I might say that I have been asked by supervisors from other railroads where safety rules are in effect, "How do you apply discipline for failure to observe safe practices?" The answer obviously is, we don't. However, when I started working for a railroad 26 years ago, one of the first things I learned was that a man was expected to do as he is told, and that, when he refuses to do so, he automatically severs his connection with the company. That still holds true. An employee must carry out the instructions of his superior, whether these instructions apply to accident prevention or other things in connection with his work. It is true that in rare instances discipline has been applied by the proper officers for flagrant violations of safety instructions given by the foreman for the necessary protection of a man doing certain kinds of work. In such instances, discipline was administered, not for failure to comply with safety rules, but for failure to carry out the instructions of his supervisor, or, in other words, for insubordination.

It seems to me that it is ridiculous for us to assume that a man on our railroad, or on any other railroad, gets hurt on purpose. He gets hurt because he, or some one else, has made a mistake, and it is through an organized educational program that we must try to avoid these mistakes.

With the average workman, it is not difficult for the supervisor, by the use of tact and a friendly attitude, to impress upon him the importance of everybody pulling together to keep men from being injured. A supervisor has a limited number of men, and by constant effort with them he will soon have built up a group of men who will take pride in a good

safety record for their department and will put forth considerable effort to maintain it. Perhaps this will not include every man under his supervision, but the safety group which he has built up will eventually take care of the others who have not become convinced.

The question is what to do about the fellow who is difficult to reach by ordinary methods—this one man in a hundred who has to be talked to in a different language. This is a difficult question to answer because it is impossible to lay down a hard and fast rule as to the reaction of each individual under different circumstances. Each case of this kind presents a problem in itself, which requires study on the part of the supervisor who is familiar with the man.

To secure best results, workers must be able-bodied and efficient, and to maintain and produce such men, the safest possible conditions must be established and maintained. A fearing man is most apt to get hurt, hurt others, or, in his terror, do poor work. Therefore, for efficiency, men must know that working conditions are as safe as possible, that unsafe practices are stopped, and that their fellow workers are likewise careful.

Economics Important

A supervisor's duty to promote accident prevention, even to the extent of protecting the worker from his own careless acts, may be open to controversy, but a supervisor's duty to his company, as regards the economies of accident prevention, cannot be questioned. Compensation and negligence laws have become factors in production costs, which supervisors must recognize or be superseded by those who will. That large savings can be made in personal injury costs by sympathetic and intelligent accident prevention work has been proved in thousands of industries, including transportation. On the other hand, from the employees' standpoint, it should be remembered that there can be no benefit to the company unless employees and their families are first benefited by the elimination of fatalities and serious injuries.

I do not recall who first said "safety promotion work is like riding a bicycle—stop pedaling and you fall off," but it seems to me that it is a thought which might well be kept in mind. It is not what you did yesterday or before, but what you do today, tomorrow, next week and next year, that will decide the success of your accident prevention program. Remember, when you stop pedaling—you fall off.

Railroads Battle Floods and Hurricane

(Continued from page 688)

ing of traffic was changed accordingly. When all other lines had been opened except the Greenfield-Gardner section of the main line, eastbound traffic was carried on the main line as far east as Greenfield, then north to White River Jct. and thence to Boston via Concord. The Gardner-Greenfield section of the line was opened up during the third week in October, permitting the resumption of through service on the main line at that time.

Heavy damage was inflicted on buildings and other facilities of the B. & M. by the hurricane. Especially hard hit were the shops at Concord, N.H., and wharf properties at Boston. Moreover the enginehouses at Stoneham, Mass., and Bedford were completely demolished and others at Marlboro, Mass., Wilmington, Haverhill and East Sommerville were damaged. At other places roofs were torn off, fences were destroyed and extensive damage to windows occurred. Likewise signal and communication facilities suffered extensively.

Showing a Bad Washout on the B. & M. at Irving, Mass.

Other Lines Also Suffer

On the Boston & Albany, extensive damage was sustained by the company's main line between Boston and Albany, N.Y., and through service on this line was not restored until October 1. At Brookfield, Mass., on this line, flood waters from a broken dam in Five Mile river destroyed a deck plate-girder bridge having a span of 36 ft. and it was necessary to build a temporary trestle 200 ft. long. At West Brookfield, Mass., the track was under water for 2,000 ft., while at West Warren four tracks were washed out to a depth of about 15 ft. for a length of approximately 200 ft. Further extensive washouts were experienced at Russell, Mass., where 1,000 ft. of roadbed was destroyed to a depth of 15 ft. or more and at a point two miles from Russell where Taylors Brook washed out 500 ft. of track to a depth of 20 ft. Numerous additional washouts occurred at other points on the main line and also on branch lines. Building destruction on the B. & A. included demolition of the brick freight houses at South Spencer, Mass., and West Brookfield, while the doors and roofs of the company's wharf properties at Boston were torn off and otherwise damaged.

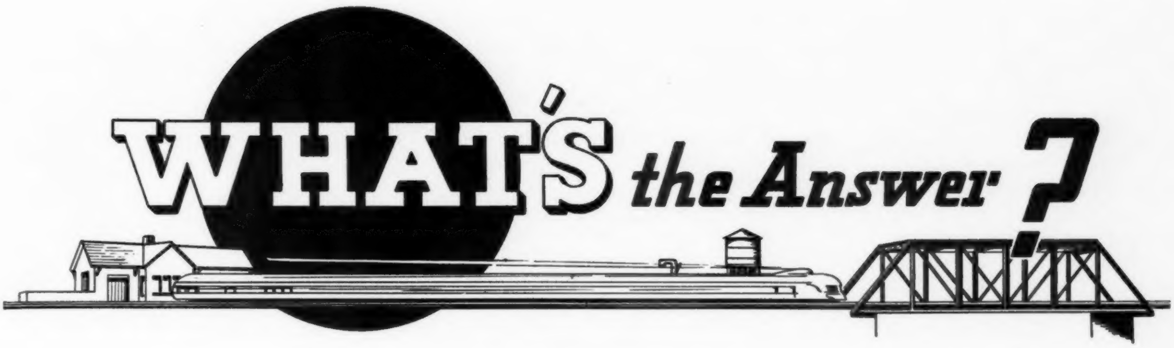
The Central Vermont suffered chiefly at New London, which is this company's southern terminus. The road's Water Street freight house and bridge and building shop at that point were completely demolished while other buildings, both large and small, suffered extensively. Flood damage was also suffered at outlying points and important reconstruction work was done at Palmer, Mass., and Three Rivers, and at Stafford, Conn., Lebanon, Cantic and Norwich.

Although the Rutland was seriously affected by washouts and high water no bridges were lost and in this respect the road fared far better than during the floods of 1927, following which almost 300 of its total of 407 route miles had practically been rebuilt. However, it was more than a week before service was restored on all this company's line.

The New York Central suffered from the storm chiefly on its Putnam and Harlem divisions out of New York City. However, difficulties on both of these lines were attributable to minor washouts and the destruction of several small bridges and service was fully restored within a few days.

Because of the exposed position of its lines, the Long Island was probably the most severely affected line in the vicinity of New York City. Numerous washouts occurred between the Hamptons and Montauk, at the east end of Long Island and severe washouts occurred on its other lines. This company also suffered delays because of power failures and inability to continue third-rail operation.

Lines in New Jersey, including the West Shore; the Delaware, Lackawanna & Western; the Central of New Jersey and the Erie suffered comparatively little damage.



Building Up Rail Ends

Can rail ends be built up indefinitely by welding? If not, why? If so, what factors determine when the rail should be renewed?

Limited Only by Fatigue

By J. G. Hartley
Assistant Engineer, Pennsylvania,
Philadelphia, Pa.

Rail ends can be built up until the fatigue point of the metal has been reached. However, this point is seldom, if ever, reached in rail since the fishing surfaces wear to the point where, unless oversize bars are applied, the building up of the rail ends will give only temporary results. Both new and reformed oversize bars are practically limited in the oversize feature to their original section, for which reason, if the life of the rail is to be prolonged when the wear on the fishing surfaces becomes too great for the commercial or reformed bar to fit, the only remedy is to crop the rail and relay it. The question, therefore, reduces itself to the amount of traffic carried by the rail and the possible size of the reformed or new oversize bars that can be obtained to provide the proper amount of drawing space between the bar and the rail. When it becomes impossible to secure such bars the rail must be cropped.

This Subject Needs Study

By E. L. Banion
Roadmaster, Atchison, Topeka & Santa Fe,
Marceline, Mo.

This is a live subject which, to my mind, should be given more intensive study than any other that I know of. In the past, the building up of rail ends, the lasting qualities of the welds and the determination when the reconditioned rail should be renewed, have been decided largely by the general condition of the worn rail. With the heavier rail sections that are now in vogue, the situation has changed and the chief concern is to make the rail ends give the same service as the remainder of the rail.

Rail life is governed largely by the wear on the fishing surfaces. When this reaches the point where the joint bars no longer perform their function properly, there is a noticeable drop in the rail end, the bolts can no longer be kept tight and a low joint results. The rate of this wear is much less in the heavy than in the light rail sections under the same conditions of traffic and roadbed, but it still exists. Failure to maintain the rail at the joints frequently causes early renewal of otherwise sound rail.

It is only within recent years that measures have been taken to overcome batter at the rail ends and wear on the fishing surfaces, expect to rebuild the rail ends by welding. It is now known definitely that welding alone will not solve the problem of rail-end maintenance. To obtain a lasting improvement at the rail ends several factors must be considered: (1) Do the rail ends have sufficient hardness to withstand the forces that are applied to them by traffic; (2) the rate of wear on the fishing surfaces; (3) the mistaking of rail-end droop for batter; and (4) attempts to correct by welding a condition that does not actually exist.

End-hardened rail shows less batter and wear than rail that has not received heat treatment. Yet, heat treatment has brought a type of failure not previously noted, for not infrequently a section of the hardened rail, ½ in. thick, 2 to 3 in. long and the full width of the head, breaks out

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in January

1. *What considerations determine the minimum weight of rail that should be used in yard tracks? In leads and running tracks? In ladders?*
2. *Is it feasible to use creosoted wood for the construction of window sash? If not, why? If so, what are the advantages? For what service are they best adapted?*
3. *What precautions can be taken to prevent the accumulation of ice on tracks at water stations? Who should do this?*
4. *What materials are suitable for protecting overhead structures against the effect of locomotive blasts? What are their relative merits? How should they be placed?*
5. *What measures should be taken to insure thorough inspection of switches and switch stands? What details should receive attention? Should inspections be reported? If so, how and to whom?*
6. *What difficulties, if any, are met in air-lift pumping during the winter that are not encountered in warm weather? What can be done to overcome the trouble?*
7. *Should curves on industry, house or other low-speed tracks be super-elevated? Why?*
8. *What provision should be made for fire prevention and for fighting fires at coaling stations?*

under traffic. This fracture has much the same appearance as a transverse fissure, except that it is horizontal instead of vertical.

On multiple tracks carrying directional traffic, much of the measured end batter disappears when the joint bars are reversed, new bars are applied or other means are employed to compensate for the wear on the fishing surfaces. In making tests with a straight edge and taper gage, I have often found that droop was mistaken for batter. This is not said for the purpose of minimizing the seriousness of battered rails, or to characterize as useless the building up of rail ends, but rather to outline some of the unsatisfactory conditions that must be corrected if we are to obtain proper value for the money we spend in building up rail ends.

This then brings us to the question. Rail ends can be built up satisfactorily by welding only so long as batter is the major defect. When end droop, caused by worn fishing surfaces, becomes predominant, the application of additional metal to the rail head becomes a waste of money. However, there are several methods of conpensating for wear on the fishing surfaces, including the use of new oversize joint bars, reformed or crowned bars or rail joint shims. As a last resort, the rail can be cropped. If shims that are too thick or bars having too great an addition to the normal section are used, the entire bearing will be placed at the point of added thickness and the results will be unsatisfactory.

Because so many factors are involved, further study of the whole subject of joints, joint design, joint wear and joint weakness, is needed. Possibly a longer joint bar to eliminate or reduce fishing wear or some other method not yet suggested can be employed to eliminate the abrasive action that causes fishing wear. When this ideal is reached, rail ends can probably be built up indefinitely by welding.

Welding Not Only Factor

By Armstrong Chinn
Chief Engineer, Alton, Chicago

Rail ends can be built up by welding so long as there is sufficient rail head left to act as a base to support the new metal. So long as there is enough head to carry the traffic, there will be enough to support the new metal. However, certain practical considerations enter into the problem. Important among these is the fact that it will not do much good to build up rail ends unless they are firmly supported by well-fitting joint bars. As rail wears, the fishing surfaces of both the rail and the joint bars wear. Often, before the rail itself is worn out, the fishing surfaces will become so worn that the joint bars can no longer be tightened properly. When that time comes, a welding program for building up the rail ends should be accompanied by a program of reconditioning the joint fastenings. This may be accomplished by the application of oversize bars, or of bars reformed to compensate for the wear or by the use of joint shims with the existing bars.

Many factors are involved in the determination that rail should be renewed and they vary with the class of track. The only thing that can be said definitely is that there is no definite answer to this part of the question. In general, however, rail is removed from main-line tracks when it no longer rides satisfactorily for the class of traffic it carries, and from other tracks when it is no longer strong enough to carry the loads that must pass over it.

Preparing for Winter

In what ways should section forces make special preparation for winter?

Drainage Is Important

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Among the most important items of preparation for winter is that of drainage. If this is not done before freezing weather it may be impracticable to do it at all. Unsafe conditions may be created, and much time will be wasted in chopping ice that would not have formed if proper attention had been given to drainage at the right time. Provision should be made for draining water from tracks, turnouts, and water stations. This is particularly important where water tanks may overflow, since it is possible that sufficient ice may accumulate over one or both rails to cause a derailment.

Ditches along the foot of embankments should be cleaned to insure a free channel for the disposal of water from melting snow during the winter and from spring rains. Brush, dirt and drift should be cleaned from all culverts, to avoid blocking the water from melting snow and heavy rains. Washouts have occurred where this was neglected. This is particularly important in the mountains and in hilly country where the runoff is rapid and the waterways are sometimes restricted, or where they bring down heavy loads of sediment.

It is equally important to have the track in the best line and surface that is practical with the force available, for after the track is frozen ordinary lining and surfacing are impossible. All necessary gaging should be completed before the advent of winter. If there are any stretches where the rail is showing a tendency to tip, it should be straightened during the process of gaging. Efforts to do gaging and other work which require spiking is certain to damage the ties much more when they are frozen than when they are are not. For this reason, this type of work should be kept to the minimum during the winter season. In this connection also, churning ballast should be dug out and cleaned or replaced with clean ballast. It is scarcely possible to keep smooth winter track on ballast that has been churning.

Switches should be gone over out of face to insure that bolts are in place and tight, and that all cotter keys are in place. If any bolts are worn they should be replaced with new bolts. Ballast should be cleaned away from the switch rods so that there will be no interference with their movements. All parts should be adjusted so that they will fit tight and lost motion be taken up. These items are important at all times, but doubly so upon the approach of winter when emergencies may make it difficult to follow routine procedure for long periods. Tight bolts in the joints away from switches are also important, for while they can be tightened in cold weather, it is advisable to have this out of the way before winter comes on.

No foreman should allow winter to catch him with any of his highway crossings unattended to, for there is little likelihood that he will give them the needed attention after winter arrives. If he does so the job is quite likely to be unsatisfactory and will require an unreasonable amount of labor. This is a place where provision for drainage is also of the first importance.

I have mentioned only the most important of the items that need attention before winter. There are many

others, some of which are purely local in character, which will vary with the territory and local conditions.

Many Things To Do

By Joseph H. Becker
Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

There are many things for the section forces to do if they are to have conditions in the best possible shape for entrance into winter. The track should be put in good line, surface and gage; highway and street crossings should be gone over to insure that both the track and highway are in good surface and that drainage is adequate; churning ballast should be removed and replaced with clean material. Switches should be cleaned so that there is ample space for the accumulation of snow and ice without interfering with the operation of the points, and ditches should be constructed to lead water from melting ice and snow or rain away from them. All surface drainage ditches and those leading to culverts and bridges should be cleared of vegetation and debris to insure an open channel. In other words, all defects in line, surface, gage, drainage, turnouts, etc., should be corrected and the whole track and roadbed should be put in such condition that they will require minimum attention after freezing sets in and ice and snow begin to accumulate.

Education in Safety

What practical methods can be employed to educate maintenance forces in accident prevention? Who should conduct the program?

Strive for Safety Record

By W. E. Folks
Track Supervisor, Cleveland, Cincinnati, St. Louis & Chicago, Cincinnati, Ohio

Maintenance employees should be taught that their work requires more than ordinary precautions to overcome its inherent hazards, and that any carelessness on their part may result in injury or death to themselves or their companions. The heads of the department should build and direct a practical program of accident prevention. This program should be devised to get quick results, be easily carried out and far reaching in its implications.

Safety measures should be widely and persistently advertised. The personal benefits inhering in these measures and the personal losses that may be incurred by ignoring them should be stressed in the advertising campaign. In addition to this, employees should be taught that safety practices in their own homes are as important as during their working hours, and that if they will follow these practices consistently when away from work they will more quickly and effectively acquire safe habits.

Infractions of the safety code must not be tolerated by either supervisory officers or the higher officers of the department. There must be a constant striving for a good safety record from the highest officer to the laborer. Simply talking safety is not enough; it must be taught by example as well as precept, for the men are quick to sense whether the campaign is superficial or deep seated. If they are convinced that their supervisors are in earnest, they will be too. If they observe that what is preached is not practiced, they will be indifferent and the educational effort will be a loss.

Make the Objective Clear

By P. F. Buckle
Assistant Superintendent of Safety, Chicago, Burlington & Quincy, Chicago

In devising methods for education in accident prevention, the objective must be made clear. The department head, generally the superintendent, has the responsibility for outlining the objective. The next subordinate officer, the division engineer and through him the roadmaster and the supervisor of bridges and buildings, should say how the objective should be accomplished. The actual director of the work, the gang foreman, should see that the job is done. The department head must, of necessity, receive inspiration from the executive as the result of a stated managerial policy.

The worker usually is not only willing but anxious to do what is wanted of him if he can find out what is wanted. If he comes to know that his foreman is really interested in the safety and well being of his men, the worker will respond in an effort to emulate the foreman's example and thus please the boss. He will either consciously or unconsciously be looking out for his own safety and the safety of his fellows.

Complete familiarity of the individual with safety and other rules is essential to any safety campaign, and this can be accomplished only by study. Some laborers are unable to read the rules, or at least unable to grasp their meaning. In such instances the foreman has the responsibility of explaining the rules to the men.

To carry on the educational work that is so essential if safety is to be conserved, one must select the supervisory forces not alone for their ability to perform the work over which they are given jurisdiction, but for their ability to handle well the most valuable and indispensable element in any organization — men. Regardless of his rank, the supervisor, both by precept and example, must indicate to his subordinates what is expected of them.

It is highly desirable that members of the department personnel be given the particulars of any personal injury that occurs in their ranks, telling how it occurred, the rule, if any, that was violated, how the injury resulted and what might or should have been done to prevent it. It is especially important that supervisors of all ranks be given this information, for it will help them to carry on their work of education.

The foreman should take a few minutes every day to explain in a "huddle" meeting the rules and why it is desirable to do work in certain ways in the interest of safety. Before any job of an unusual character is undertaken, the gang should be called together and the job discussed thoroughly, so that every man will know what is expected of him. Above all else, the foreman should be friendly in his attitude toward his men, for they will react favorably to such treatment, thus making it easier to educate them to follow safe practices and to notice and correct unsafe conditions.

Must Be No Weak Links

By E. G. Evans
Superintendent of Safety, Louisville & Nashville, Louisville, Ky.

The first step in the education of the maintenance forces in accident prevention must be the establishment of a safety department fully and heartily supported by the management, and of a safety program based on natural laws affecting the structure and reactions of the human body, as well as on the invariable laws affecting

the material and equipment with which maintenance men work. The first purpose of such a program must be the making of a part of the education of every member of the maintenance department the laws concerning the work that he has to do that relate directly to his health and safety or to the health and safety of others with whom he is associated.

The first move in such a program must be to convince the heads of the maintenance department of the economic and humanitarian necessity for it and to imbue them with the possibilities it offers, and then these department heads, chief engineer, engineer maintenance of way, track supervisors and foremen, those who are in daily contact with their men, must carry the program to the men and see that it is executed.

In the chain carrying the program from the safety department to the men there must be no weak links. If the safety work is to succeed it must be a 100-per cent affair. Let a single supervisor or foreman fail to join in the work and the utmost in accomplishment can never be attained, for sooner or later men under that supervisor or foreman will be injured and the record will be spoiled.

An especially devised departmental book of safety rules will be found to be a basic feature of such a program. A copy should be made the registered and permanent possession of each man in the maintenance department, and the foreman should base his efforts to educate his men on this book. At meetings of the men, some of which should be called formally and include men from many of the gangs, and others held informally by the men of a single gang before they start to work or during their lunch hour, these rules should be discussed. The reasons for each rule should be dealt with, and the results of its violation speculated upon. The importance of these activities cannot be over emphasized.

Provision for the display of safety posters and other educational matter should be made at the headquarters of each gang. Periodic inspections of all tools, motor cars, and other equipment must be made; foremen must not any more permit their men to use tools that are in dangerous condition or ride on motor cars that are not being maintained safely, than they would permit them to indulge in unsafe practices and habits.

To determine whether all men are carrying out that part of their duties which relate to safety, supervisors must check up on tools, equipment and the practices of the gangs and foremen. Conditions in general on each supervisor's district must be checked by the division engineer and members of his staff. Safety inspectors, representing the management, must observe and report in detail conditions under the jurisdiction of each division engineer. In all cases the responsibility for unfavorable conditions or records must be laid squarely at the division engineer's door, to be passed by him down the line to the supervisor, foreman and men intimately concerned. The impetus for safety work in the maintenance department, as in all departments, must start at the top and work down.

Freezing of Tank Valves

What methods should be employed to keep tank valves from freezing in extremely cold weather?

Suggests Several Methods

By R. D. Anderson
Division Engineer, Chicago & North Western, Huron, S.D.

Several methods may be employed to keep tank valves from freezing in extremely cold weather. Probably the oldest of these is to house in the lower portion of the tank structure, that is, enclose the frame from the tank floor to the ground and install a stove or steam heat within this enclosure. As a general rule, however, such a housing is detrimental to the structure, because moisture is retained when the heating equipment is not in use, causing metal parts to rust and the timber to decay. We have used a modification of this plan by reducing the area of the enclosure, housing in only the stove under the tank. To do this we use sheet iron, applying scrap box-car roofing if it is available. We use a 6-in. wrought iron pipe for the stove pipe, extending it through the floor and roof of the tank, and placing it as near to the tank valve as practicable.

Another method which will defer the freezing of the tank valve is to raise it a foot or more from the floor of the tank by means of a metal pipe extension or by means of a heavy timber bolted to the floor and to the valve, through which a hole the size of the outlet valve has been made. Where tanks are supplied by flowing wells which discharge directly into the tank, if the outlet for this discharge is placed close to the tank valve, it will afford some protection against freezing. Removing all, or a portion, of the water in the tank and refilling it with fresh water from a well will keep the tank valve open if the changes in water are frequent enough. In mercoid-controlled electrically-operated plants, a small drain back to the well will accomplish the same result.

Associated with the freezing of tank valves in severe winter temperatures is the freezing in the valve rod when the surface of the water in the tank freezes over. The best solution we have found for this problem is to use an anti-frost valve rod. This is merely a pipe filled with alcohol, extending from the tank valve to the top of the water in the tank, through which this rod operates. Obviously, the lower end of this pipe must be fitted and packed so that the rod can work freely without allowing the alcohol to escape or water to enter.

All of the foregoing schemes have been tried out on our lines in Minnesota and Dakota. All have been reasonably successful and have largely removed the difficulties we have experienced in keeping water stations in operation when winter temperatures fall to 20 and 30 deg. below zero.

Heat Gives Best Results

By Water Service Inspector

It is almost certain that tank valves will freeze under continued low temperatures, especially when the supply is taken from streams, unless some provision is made to prevent it. In my experience I have found that the application of heat is the best preventive of the trouble. When I was engaged in division work I found it helpful to pipe the exhaust steam from steam-driven pumps into the tank, arranging so that the heat would be applied near the tank valve. This is also very helpful in keeping float valve gear free from ice. In some cases, where exhaust steam was not available where the pumps were shut down for considerable periods, I have made connections so that a small amount of live steam could be supplied.

Where internal combustion engines or electrically-operated pumps are in service, this source of heat is not available unless a special boiler is set up for this purpose. In some cases of

this kind I have enclosed the tank frame, placed a stove in the enclosure and extended an 8-in. wrought-iron pipe from the stove through the tank to a point above the roof, to serve as a stove pipe. The heat from this pipe is sufficient to keep the temperature of the water in the tank above freezing.

Where a stove is installed in this way, it is necessary to provide an inlet for fresh air or the fire will go out. Great care is necessary to insure against fire. I remember in one case, that one night the section laborer who looked after the fire failed to lock the door to the enclosure, and some tramps entered, built a roaring fire in the stove and burned the tank down.

Programming Work in Yards

To what extent can the maintenance of a large yard be programmed? What are the advantages and disadvantages?

Considers a Plan Vital

By W. Allan
Section Foreman, Canadian Pacific, Montreal, Que.

While track maintenance in a yard does not differ basically from that on main tracks, there are special features connected with yard work that are not met with on main tracks. These include frequent interruptions, sometimes long continued, especially where a track is suddenly demanded for the storage of cars; the intensive use of certain tracks or portions of tracks; the large number of turnouts; the fact that in some yards the rails are light and almost worn out before they are applied; and the necessity for stopping work to repair the damage caused by derailments.

A large yard should be divided into sections, each having about the same amount of work, the size of the sections being determined by the different classes of tracks, the number of turnouts, the drainage conditions in the yard and the volume of business handled. In such a yard, the track work is generally in charge of a yard or general foreman who has a number of assistant foremen whom he assigns either to fixed territories or to certain classes of work.

A program of work for a month or for a full season should be prepared by the roadmaster after consulting with the general foreman, and each assistant foreman should be given a copy. Usually, this program cannot be carried out in its entirety, but it is a great help in getting the work done. Where a scheduled job cannot be done at the time selected, because of interference by yard operations, it can be deferred until conditions are more favorable, and the next job can be undertaken.

It is important that the yard foreman and the yardmaster co-operate in getting the tracks cleared for the purpose of making the scheduled repairs. If there is any reluctance on the part of the yardmaster in giving this co-operation, he should be made to understand that his own work will be made easier if the tracks are kept in good condition. At one time an export yard may be crowded with cars awaiting movement; at another it may be a storage yard that is full of cars awaiting orders; while at still another some special movement will make it impossible to do work on certain tracks, such as in an elevator yard during the grain season. These conditions rarely occur at the same time, however, and a little diplomacy will nearly always make it possible to get a track that will keep the work going, generally without breaking too much into the schedule.

Heavy rail, tie plates, anti-creepers, good ties, ample ballast and adequate drainage all affect the amount of work required in yard maintenance. Where heavy cars and locomotives are operated over light rail, yard maintenance is heavy, especially on ladders and at other turnouts. In any yard, derailments and wear on switches can be reduced by the installation of switch-point guards, or by milling the stock rail in such manner as to provide a housing for the switch points. Either practice will prevent the flanges of the car wheels from coming into contact with the point for 4 or 5 in. back of the end of the point. If manganese switch points and bent stock rails are installed the switch-point guards are not necessary.

Drainage is often troublesome in yards owing to the large flat surface and the lack of gradients sufficiently sharp to carry water off quickly. Any program of yard maintenance should contain an item for improving the drainage or for its maintenance if it has already been applied. Pipe or French drains may be necessary, and the latter require renewal at stated intervals. Yard foremen should see to it that the yard is kept clear of rubbish, scrap and track material, as well as material that will likely interfere with drainage, and a certain amount of time should be provided in the schedule to include this class of routine work.

Taken all in all, I consider a planned program of work a vital necessity for orderly work in a yard. The fact that the time element cannot always be followed does not circumscribe the importance of having a plan and of carrying it out as carefully as the peculiar conditions of yard work will permit.

Has Many Advantages

By District Engineer

It is axiomatic that unless work is systematized it is rarely done efficiently and, it might be added, very effectively. I know of no better way of systematizing maintenance work than through a program prepared after thorough study of the conditions surrounding the particular locality or the particular class of work to be done. I think that most roads now prepare a general schedule for their major maintenance operations, and many of them do so for the remainder. Roadmasters, in particular, should have a program for their routine maintenance. I have always insisted on programming the work on each section and that for bridge and building gangs.

I have heard numerous roadmasters and a few officers of higher rank say that it is useless to go to the trouble of preparing a schedule of work in a large yard, since it rarely occurs that such a schedule can be carried out. To my mind this is a superficial view. It is true that quite often a time schedule cannot be followed closely, but my experience indicates that a well considered program can be followed closely enough to warrant the time and effort required for its preparation. Any schedule, even that for an ordinary main-line section, is likely to be interrupted by conditions that are not under control, but I have never heard this advanced as an argument for discontinuing the program for this section.

The same principle applies to the yard. The fact that the yard foreman has a plan and endeavors to follow it as closely as practical will cause him to systematize his work, which is the objective of all programs. If he cannot get the tracks that are scheduled for this week, he has only to turn to

some other item on the schedule and complete it, returning to the one that he has passed over as soon as the tracks can be released to him.

I want to emphasize my belief that no one can do either the best work or the maximum amount of work if he attempts to do it in a hit and miss manner. The person who does not have a clearly defined objective never gets anywhere. One of the best trackmen I ever knew was the poorest foreman of my recollection, for he never followed any plan, even when it was worked out for him. The same is true of any foreman who does not have a plan of his own or is incapable of following one which is presented to him.

As important as system is everywhere, it is of greater importance in yard maintenance where so many digressions are necessary. If there is no program to guide the efforts of the yard forces, these efforts are quickly dissipated in the maze of minor items that must always receive attention, and very shortly the work will degenerate into a haphazard performance that accomplishes nothing of a constructive character.

Wall Board Versus Plaster

Under what conditions is it desirable to use wall board instead of plaster? Why?

On Minor Work

By A. T. Hawk
Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

For a number of years we have done very little plastering, as during this time numerous substitutes that are well adapted for wall finish, have come on to the market. These materials present a good appearance and have the advantages that they are cheaper, easier and quicker to install, make very little muss and can be applied by the regular maintenance forces. They include plasterboard, fibreboard, plywood and other factory-made materials that can be used to advantage without the employment of specialized labor. There is still a considerable field for plaster-finished walls and ceilings, especially in offices and elsewhere where these surfaces are large, but for minor work, even when it is of importance, the use of some type of plaster substitute has become almost imperative. Today, however, even walls of large area that ordinarily would be plastered are being constructed of other materials for acoustical or decorative reasons.

Depends on Size of Job

By O. G. Wilbur
Assistant Engineer, Baltimore & Ohio, Baltimore, Md.

The use of wall board in railway building construction will depend in large measure upon the permanency of the installation, the size and the location of the work. The use of wall board on a permanent job of any consequence is hardly recommended. It can be used to advantage on small jobs, particularly where the construction is more or less temporary and where the cost of plaster would be out of proportion to the size of the job. In jobs of this kind, the wall board can easily be applied by carpenters and the seams or joints between the sheets can be covered by the usual system of paneling strips by the same labor. There is a recognized method of sealing these joints with a cement and by the use of other materials which eliminate the paneling strips which are sometimes undesirable. There are localities, however, where labor regulations provide that this cementing must be done by plasterers. Where these restrictions are in effect the ultimate cost reflects only a slight saving, compared with a plaster job, which is better construction.

Conditions are so variable with respect to location that very little discussion, either favorable or unfavorable to wall board, can be offered. In a case of construction at a point where it was believed that no plasterers would be available and that the use of wall board would thus be the economical form of wall finish, it developed that the contractor was able to employ a local plasterer at a price that made the plaster job the more desirable.

Wall board might be used to considerable advantage in temporary partitions where the paneling of the joints in the finished wall would not be objectionable. It might also be used where alterations are required and it is necessary to keep the facilities in the building in service, in which case it would be desirable to avoid the dirt and muss which customarily are an accompaniment of plastering.

Derrick Car vs. Locomotive Crane

What are the relative merits of the ordinary derrick car and the locomotive crane for bridge maintenance?

Prefers Locomotive Crane

By John L. Vogel
Bridge Engineer, Delaware, Lackawanna & Western, Hoboken, N.J.

In comparing the relative merits of the derrick car and the locomotive crane for bridge maintenance, the advantages of the latter are so evident that it is difficult to make a comparison. Briefly, the modern locomotive crane is so designed and equipped that it is adapted for many kinds of work, whereas the range of work for which the derrick car is adapted is much more restricted. The locomotive crane is self-propelled, while, generally, the derrick car requires outside power to move it. It is not necessary to resort to a turntable or a wye for the purpose of heading the boom of a locomotive crane for reverse operation, since it is full revolving. On the other hand, the derrick car cannot reverse, for which reason the car must be turned if it becomes necessary to reverse the direction of the boom. In other words, a locomotive crane can load or unload cars placed before, back of or on either side of it, while cars must be placed directly in front of the derrick.

Modern cranes are equipped with a worm hoist on the boom, which eliminates the hazard of the boom dropping or rebounding if the dog ratchet slips. Again, since the ordinary derrick car has but three drums, except when equipped with a special engine having four drums, it is not suitable for driving piles or handling a clamshell bucket, while the modern locomotive crane can be used for pile driving with leads or for handling a steam hammer without leads. It can also operate a clamshell bucket that does require a single hand line. The modern locomotive crane is also

equipped with a generator, with lights and a pump. When the crane is working at right angles to the track its stability is assured, the possibility of tipping being overcome by a counterweight, whereas a derrick car must be anchored when doing heavy lifting on either side of the track.

Many Still in Use

By General Bridge Inspector

As long as two or three decades ago, when the locomotive crane had been developed to a capacity of 15 tons, it was freely predicted that the day of the bridge derrick car was past. Despite the fact that the locomotive crane has been greatly improved since that time, while similar improvements have not been made to the bridge derrick car, a surprisingly large number of them remain in service. It has been suggested however, that the fact that it is one-purpose equipment may have something to do with this, although the high cost of the cranes is an important factor.

It cannot be denied that locomotive cranes are flexible, being adapted for many classes of work for which the derrick car is not suited. Most derrick cars are not self-propelling and those that are are generally so slow moving that this feature is of limited benefit. On the other hand, locomotive cranes are self propelling, and can be moved much more quickly, no changes or preparation being necessary to throw in the propulsion gear. Locomotive cranes are full revolving and can be used at right angles to, as well as directly over the track, and in any intermediate position. The greater speed of operation demonstrated by the locomotive crane is a distinct advantage for many kinds of work, but is not so obvious when lifting heavy loads. This speed of operation often shortens the time required for the execution of work. The ability to work in any position is not the least of its advantages, for it sometimes happens that certain kinds of work can be approached from only one direction.

Few divisions on a railway can keep either a bridge derrick car or a locomotive crane busy all of the time on bridge maintenance. One of the important advantages of the latter is that it can be employed for a great variety of work and thus be kept in operation during the intervals when it is not required by the bridge gang. On the other hand, this is one of the serious drawbacks of the locomotive crane, for it is adapted for so many kinds of work that the demand for it is always insistent and in some cases it is difficult for the bridge forces to command its service when needed.

Locomotive cranes of 20-tons or greater capacity, are far more serviceable for bridge maintenance than derrick cars of equal capacity. Yet the ordinary division cannot justify their purchase for bridge maintenance alone, partly because of the expense involved and partly because of the limited time that it will be engaged in this class of work. However, if there is sufficient other work for which it is adapted to make its ownership profitable, the purchase can be fully justified. A word of caution is necessary in this connection. One frequently sees locomotive cranes of large capacity engaged on work that could be done to better advantage by a 1 or 1½-ton crane. It is a waste of money to put a large machine at work on a small job, partly because of the idle capacity and partly because the smaller crane can do the work so much faster. A 1½-ton rail crane will load, unload or lay far more rail in a given time than a 20-ton crane, simply because it is quicker in action, while it is working closer to its ultimate capacity and the cost of operating the rail crane is less.

Paint on Plaster Walls

Can paint with linseed oil as the vehicle be used on plaster walls? If so, what methods of application are necessary?

Customary To Use It

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

Interior painting generally presents a problem differing from that of exterior painting, as gloss paint is used on practically all outside surfaces, while flat or semi-gloss finishes are prepared for interior work, particularly on plaster surfaces, because of its softer and more subdued effect, and because it is easier to keep clean by washing. Paint having a linseed-oil vehicle can be used on plaster walls; in fact, it is customary to use such paint, especially for the priming coat. Succeeding coats can be of the same paint, with the addition of a quantity of flatting oil, turpentine and a small amount of drier. The priming coat should consist of 6 to 7 gal. of the best boiled linseed oil and about 1 gal. of turpentine to 100 lb. of white lead. The second and third coats should be mixed with flatting oil, but, as a substitute, turpentine can be used with about a pint of drier.

To insure a good job, three coats should be applied, especially on new work, but where a wall has been painted previously, the existing paint, if in good condition, may be considered as the primer and only two coats applied. The preparation of the surface is quite important. It must be perfectly clean and smooth, the latter being attained by going over it lightly with fine sand paper.

New plaster should not be painted for several months, as the alkali which it contains will retard the drying of the paint and cause it to fade, leaving the wall spotty. However, if it becomes necessary to paint before the wall has dried out thoroughly, it may be washed with a solution of 2 lb. of zinc sulphate to 1 gal. of water, allowing it to dry before painting.

Must Be Aged

By Master Painter

Plaster contains lime, an active alkali, which attacks animal and vegetable fats to saponify them. The only difference in the result is that in the ordinary soap-making process the soap is soluble in water while the calcium soap is insoluble. When the plaster is new it contains considerable free lime, which in the course of time combines with the carbon dioxide in the air to form calcium carbonate, that is, ordinary limestone. To apply linseed oil successfully, therefore, the plaster must be allowed to "age" until the free lime has been neutralized naturally by combining with carbon dioxide; or it must be aged artificially with some substance that will give the same result. Experience has shown that where new plaster must be painted it should be treated with a solution of zinc sulphate. Obviously, after this treatment, it is necessary to make sure that the surface is absolutely dry before the paint is applied. In some cases a second treatment is required before the lime is fully neutralized. If there is no great hurry about the painting, better results will be obtained if the wall is allowed to age for a year before it is painted.

PRODUCTS of Manufacturers

Vapor-Seal Lath Prevents Condensation

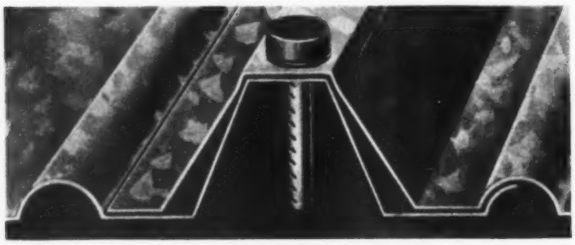
THE Celotex Corporation, Chicago, has developed an insulating lath that is said to minimize condensation of moisture within building walls and ceilings. Celotex Vapor-seal lath, as the new product is called, is essentially a cane fibre board to which is applied a vapor barrier consisting of coatings of asphalt and aluminum. It comes in sheets 18 in. by 48 in. in area and ½-in. and 1-in. thick. The ½-in. thickness is coated on the back side with the vapor seal, while the 1-in. thickness has the vapor seal midway between its surfaces. It is intended that this lath be applied in the warm part of the wall so that the vapor barrier is safely above the usual dew point, even in winter weather. The lath may be used in conjunction with wood sheathing or with Vapor-seal sheathing, a product more or less similar to Vapor-seal lath, and in the thickness desired, depending upon the temperature and humidity conditions to be encountered.

Tests indicate that a high degree of insulation is obtained where ½ in. of Vapor-seal lath is employed with 1 in. of Vapor-seal sheathing, it being said that this combination results in a reduction of 40 per cent in heat losses through a wall as compared with ordinary plaster, lath and sheathing. If 1-in. Vapor-seal lath is employed in conjunction with 1-in. Vapor-seal sheathing, which is recommended by Celotex engineers for new construction in regions where winters are severe and for buildings where a relatively high humidity is to be maintained, it is said that heat loss through walls is reduced approximately 52 per cent as compared with ordinary wall construction. When Vapor-seal lath is to be used alone, without other forms of insulation, for top floor ceilings and for outside walls, it is recommended that the 1-in. thickness be used to give moisture protection.

New Armco Seal-Krimp Roofing

A NEW kind of galvanized roofing, known as Armco Galvanized Seal-Krimp Roofing, with a patented spring-pressure lap has been developed by the American Rolling Mill Company, Middletown, Ohio. The spring pressure lap is so designed that when placed in position and nailed down, the lower end of the sheet provides a pressure-sealed water stop. The sections are held firmly together with spring tension and cannot get out of alignment.

This new roofing, which must be laid one row at a time starting at the eaves and working towards the ridge, is made in copper bearing steel, open-hearth steel and Armco Ingot Iron. Roofing accessories available with Seal-Krimp include an adjustable ridge roll, end wall flashing and gambrel joints. The adjustable ridge roll is made in two pieces to fit any ordinary roof pitch without bending or malletting, and may be adjusted lengthwise to fit V's on either side.



The Spring-Pressure Lap of Armco Galvanized Seal-Krimp Roofing

It is claimed that this spring-pressure lap makes Seal-Krimp storm-proof and weather tight, that it is easily installed, and that it is adapted for use both as roofing and as siding.

Gas-Driven Concrete Vibrator

A NEW line of gas-engine driven internal concrete vibrators has been added to the products of the Syntron Company, Homer City, Pa. Each complete outfit in the new line consists of a power unit mounted on either a pneumatic-tired wheelbarrow chassis or a swivel pedestal base, a flexible shaft, and a vibrating tool.

The Vibrator Is Driven Through a Flexible Shaft By a Small Gas Engine

The power unit is a 4-cycle, air-cooled Wisconsin engine of 3-hp. capacity, which is equipped with an automatic clutch and a power takeoff from which the flexible shaft transmits power to the vibrating tool. The flexible shaft, heavily armored, comes in 7-ft .and 12-ft. lengths with threaded couplings, while the vibrating tool, furnished in two sizes, is made up of a strong steel cylinder, sealed against leakage, with an unbalanced shaft inside, mounted in heavy oversize ball bearings. The speed of vibration of the vibrators ranges from 3600 to 6500 vibrations per minute and is controlled through an adjustable speed governor on the engine.

NEWS of the Month

Grade Crossing Accidents Decrease

In the first six months of this year fatalities resulting from highway-railroad grade crossing accidents totaled 696, a decrease of 162 compared with the same period in 1937. In this period 1,962 persons were injured in such accidents, compared with 2,496 in 1937, and accidents at grade crossings totaled 1,651, a decrease of 517.

Roosevelt Appoints Reed on Retirement Board

President Roosevelt on October 1, accepted the recommendation of the Association of American Railroads, and appointed M. Roland Reed, formerly superintendent of motive power on the Pennsylvania's Eastern Pennsylvania division, as the carriers' representative on the Railroad Retirement Board for a five year term. Mr. Reed succeeds James A. Dailey whose term expired on August 28.

I.C.C. Classifies "Red Caps" As Railroad Employes

According to a decision of Division 3 of the Interstate Commerce Commission, "Red Caps" and other station attendants with similar duties in cities of over 100,000 population will hereafter be included within the term "employe" as used in the fifth paragraph of section 1 of the Railroad Labor Act. The commission's report points out that its order will include only those employes in cities of 100,000 population, but goes on to say that "However, there is no apparent reason why the work performed at smaller cities should be treated any differently."

Rock Island to Relocate Crossing of Cimarron River

Approximately 1½ million dollars will be spent by the Chicago, Rock Island & Pacific on a relocation project on the main line between Kismet, Kan., and Hayne, 7.88 miles long, which will reduce the distance 3.57 miles and will eliminate eight curves, reducing the curvature by 355 deg. It will also reduce the grade for eastbound trains from 0.8 per cent to 0.5 per cent, except for a short section of one per cent momentum grade. A new bridge over the Cimarron river, 1,269 ft. long, consisting of five 250 ft. riveted deck truss spans on reinforced concrete abutments and piers, will carry the track 92 ft. above the low water level. Grading on this work will total nearly 3,000,000 cu. yd.

Wage Cut Requested by Southern Pacific of Mexico

The Labor Department of Mexico has been requested by the Southern Pacific of Mexico for authority to reduce salaries 15 to 25 per cent to restore the railroad to solvency. Representatives of the Union of Mexican Railroad Workers accompanied the general manager of the Southern Pacific on an inspection of the road and will later examine the accounts to endeavor to develop a solution of the problem.

Robinson Appointed Director of Unemployment Insurance

The appointment of James Gordon Robinson as Director of Railroad Unemployment Insurance to administer the new Railroad Unemployment Insurance Act which was passed at the last session of Congress, was announced by the Railroad Retirement Board on October 1. Mr. Robinson was chosen for the position after an open competitive examination conducted by the United States Civil Service Commission, the first ever given for as high a position as that of a $10,000 a year administrator.

Shopmen Shut Down to Avoid Laying Off Men

Canadian Pacific shop employes agreed, after a closed conference between company officers and representatives of the Shop Crafts Federation of the Canadian Pacific, upon a three weeks' complete shutdown of the main shops of the system throughout Canada, effective October 24. The agreement was made in preference to a reduction of working forces. Office workers on this road are already affected by a reduction plan amounting to approximately 8½ per cent, whereby each employe will take one day off each fortnight for the remainder of the year.

Advisory Boards Forecast for Fourth Quarter of 1938

The 13 shippers advisory boards estimate that freight car loadings in the fourth quarter of 1938 will be about 3.6 per cent below actual loadings in the same quarter of 1937. Of these boards, 10 estimate a decrease in car loadings for this quarter compared to 1937, while three—the Pacific Coast, the Pacific Northwest and the Trans-Missouri-Kansas boards—estimate increases. Of the 29 commodities included in the estimate, increases are expected in 10 and decreases in 19. Loading of citrus fruits is expected to be 21.2 per cent greater in the fourth quarter of 1938 than last year, while loading of agricultural implements and vehicles other than automobiles is expected to decrease 27.5 per cent.

I. C. C. Vetoes Rail-Motor Co-ordination Plan

On September 24, the Interstate Commerce Commission, Division 5, denied the application of the Union Pacific, the Chicago, Burlington & Quincy, and the Chicago & North Western for authority jointly to acquire control of the Union Transfer Company, a motor-vehicle common carrier of freight operating over approximately 2,500 route miles in Illinois, Iowa, Minnesota and Nebraska. Concerning this decision Commissioner Eastman stated: "The time may ultimately come for a considerable degree of union between these rival branches of the transportation industry, but I am not persuaded that it has yet come. For the present, therefore, I believe that the emphasis should be on the establishment of co-ordinated truck-rail service rather than on the domination by railroad companies of trucking operations per se."

Proposes Carriers Perform All Transport Services

In a 30-page memorandum which he has proposed as the basis for a comprehensive legislative program for the transportation industry, Cassius M. Clay, counsel for the Reconstruction Finance Corporation, proposes federal incorporation of railroad companies with powers broad enough to permit them to engage in all forms of transportation. Mr. Clay points out that the co-ordination of railroads could be hastened by permitting companies in interstate commerce to engage in the general transportation business on the condition that they take out federal charters. Another proposal of Mr. Clay would confine each form of transportation to the service for which it is best adapted. Commenting on this phase of the consolidation problem, the RFC counsel said, "The motor truck, for instance, should not take from the railroads business which can be handled more economically by an existing railroad or vice versa."

Personal Mention

General

J. R. Altizer, supervisor of bridges and buildings on the Radford division of the Norfolk & Western, at Roanoke, Va., has been promoted to assistant superintendent of the Radford division, at Roanoke, succeeding the late **F. L. Burton.**

H. C. Munson, assistant superintendent of the LaCrosse-River division of the Chicago, Milwaukee, St. Paul & Pacific, and an engineer by training and experience, has been promoted to superintendent of the Iowa and Southern Minnesota division, with headquarters at Austin, Minn. Mr. Munson was born at Oslo, Norway, on June 25, 1901, and graduated in civil engineering from the State University of Iowa in June, 1923. He entered railway service on June 6, 1923, as a rodman on construction work at Momence, Ill., and in October, 1923, he was advanced to instrumentman at Marion, Iowa, later being transferred to Chicago. In April, 1928, he was promoted to assistant engineer at Chicago, and in March,

H. C. Munson

1929, he was advanced to division engineer, with headquarters at Sioux City, Iowa. Mr. Munson was promoted to trainmaster in April, 1931, and served in that capacity at Ottumwa, Iowa, Savanna, Ill., and La Crosse, Wis. On December 16, 1937, he was promoted to assistant superintendent, with headquarters at Wausau, Wis., the position he held at the time of his recent promotion.

Burchard F. Beckman, chief engineer of the Fort Smith & Western, whose appointment also as superintendent in charge of the transportation and mechanical departments, with headquarters, as before, at Fort Smith, Ark., was announced in the October issue, was born at Brunswick, Ind., on March 25, 1876, and graduated from Purdue University. He entered railway service in January, 1898, as an assistant engineer on the Chicago, Burlington & Quincy, and in March, 1900, he was appointed assistant roadmaster. He was promoted to roadmaster in March, 1902, but resigned in June, 1905, to go with the Fort Smith & Western as engineer of maintenance of way. In June, 1907, he was advanced to superintendent in addition to his engineering duties, and in September, 1914, he was appointed valuation engineer. In March, 1918, he resigned to enter private practice as an engineer, but returned to the F. S. & W. as chief engineer in December, 1921.

George L. R. French, receiver of the Rutland and an engineer by training and experience, resigned July 11, on account of ill health. Mr. French was born on May 18, 1862, at Salisbury, Mass. He was graduated from Massachusetts Institute of Technology in 1884 and that year entered the service of the Burlington & Missouri River (C. B. & Q.) at Lincoln, Neb., as a rodman in the engineering department, being engaged on the location and construction of new lines for four years, later becoming division and resident engineer. Mr. French went with the Boston & Maine in 1889, when it was enlarged by the consolidation of various New England railroads, and served as assistant engineer. He then served successively with the B. & M., as track supervisor, roadmaster, trainmaster, assistant superintendent and superintendent on various divisions. On May 1, 1912, he resigned to become general superintendent of the Rutland and was promoted to acting general manager in 1923 and general manager in 1924. Mr. French was appointed assistant vice-president and general manager in 1926 and vice president and general manager and director in 1927. He was appointed receiver May 4, 1938.

Engineering

Arthur W. Miesse, assistant to the chief engineer of the Erie, with headquarters at Cleveland, Ohio, retired on October 1.

T. C. Fredrick, assistant engineer of buildings of the Chicago, Rock Island & Pacific, with headquarters at Chicago, resigned on October 16, to enter other business.

Julian Montanez Covarrubias, has been appointed engineer in charge of buildings of the National Railways of Mexico, with headquarters at Colonia station, Mexico, D. F.

Owen Crawford, assistant division engineer on the Lousiville & Nashville, with headquarters at Mobile, Ala., has been promoted to division engineer of the Nashville terminals, with headquarters at Nashville, Tenn., succeeding **J. S. Hestle,** who has been assigned to other duties.

V. H. Carruthers, roadmaster of the Melfort subdivision of the Canadian Pacific, with headquarters at Lanigan, Sask., has been promoted to division engineer of the Portage division, Manitoba district, with headquarters at Winnipeg, Man., succeeding Thomas Martin, who retired on September 1.

E. D. Hall, chief chemist of the Erie, with headquarters at Meadville, Pa., has been appointed engineer of tests and chief chemist. **R. W. Horton** has been appointed assistant chief chemist and **C. P. Brooks** has been appointed assistant engineer of tests. **K. T. Miller,** engineer of tests at Meadville, has been assigned to other duties.

Jose Guadalue Jauregui, division engineer of the Gulf division of the National Railways of Mexico, with headquarters at Monterrey, N. L., has been transferred to the Cardenas division, with headquarters at San Luis Potosi, S.L.P., and **Antonio E. Vera** has been appointed division engineer of the Gulf division, with headquarters at Monterrey to succeed Mr .Jauregui.

A. O. Wolff, division engineer of the Canadian Pacific with headquarters at London, Ont., has been promoted to assistant district engineer at Toronto. **W. C. E. Robinson,** division engineer, of the Laurentian division, at Montreal, has been transferred to London. **W. F. Koehn,** bridge and building master of the Laurentian division at Montreal, succeeds Mr. Robinson as division engineer of the Laurentian division at Montreal. **J. A. Irvine,** division engineer at Sudbury, Ont., has been appointed assistant district engineer at Montreal, to succeed **J. H. Forbes,** who has been appointed assistant right-of-way agent at Montreal. **L. M. Duclos,** assistant engineer at North Bay, Ont., has been appointed division engineer at Sudbury, to succeed Mr. Irvine.

William Thomas, division engineer on the Chicago, Burlington & Quincy, with headquarters at Omaha, Neb., retired on October 1. Mr. Thomas was born at Grafton, W. Va., on September 5, 1868, and attended Wesleyan University. He entered railway service in November, 1892, as a carpenter helper, and in November, 1896, was transferred to the engineering department as an axeman. He subsequently advanced to head chainman, instrumentman, assistant engineer on construction, and locating engineer and engineer of construction. Notable among the various lines upon which Mr. Thomas worked on location and construction were the line between Frannie, Wyo., and Wendover, and the low grade line between Vermont, Ill., and Fredrick. On February 6, 1930, he was appointed division engineer at Omaha.

C. C. Robnett, instrumentman in the engineering department of the Chicago, Burlington & Quincy, at St. Joseph, Mo., has been promoted to division engineer, with headquarters at Hannibal, Mo., succeeding **E. E. Young,** who has been transferred to Burlington, Iowa, replacing **W. G. Boon,** who retired on November 1.

Mr. Boon was born at Chrisman, Ill., on November 2, 1870, and graduated from the University of Illinois. In 1895, he worked for six months as a recorder for the Missouri River Commission, and in 1896, he worked six months as a rodman and instrumentman on the Chicago & North Western. He again worked for the Missouri River Commission for three months in 1897 as topographical engineer. On April 28, 1898, he went with the Burlington as an assistant engineer, and in April, 1911, he was promoted to division engineer, with headquarters at Galesburg, Ill. He subsequently served in that ca-

pacity at Aurora, Ill., Beardstown, Ill., Chicago and Burlington, Iowa.

Blair Ripley, district engineer of the Ontario district of the Canadian Pacific, with headquarters at Toronto, Ont., has been appointed engineer, maintenance of way, with the same headquarters, to succeed **J. E. Beatty,** who has retired under the pension rules of the company, and **T. B. Ballantyne,** assistant district engineer, Canadian Pacific, at Toronto, Ont.,

Blair Ripley

has been appointed district engineer, Toronto, succeeding Mr. Ripley.

Mr. Ripley entered the service of the Canadian Pacific in 1907, serving successively at Medicine Hat, Alta., Lethbridge; Outlook, Sask.; Montreal, Que.; Kentville, N. S., and Toronto. After overseas service, Mr. Ripley returned to the Canadian Pacific at Toronto, where he subsequently became assistant engineer. He was promoted to district engineer of the Ontario district at Toronto in 1920, the position he held until his recent appointment as engineer maintenance of way.

Mr. Beatty entered the service of the Canadian Pacific as as transitman at London, Ont., on May 1, 1904. He was ap-

J. E. Beatty

pointed resident engineer in August of that year, and in 1906 became division engineer on the construction of the Guelph & Goderich railway. On October 15, 1908, Mr. Beatty was appointed assistant engineer, maintenance, and in 1910, resident engineer, maintenance, both at Schreiber, Ont. He was appointed assistant engineer, construction, Eastern lines, on February 24, 1911, assistant engineer of construction at Montreal, in 1912, and division engineer of construction, Montreal, in 1913. On February 12, 1915, Mr. Beatty became division engineer, maintenance of way at St. John, N. B.; on December 20, 1915, he was appointed division engineer in the general superintendent's office at Montreal and on January 1, 1917, engineer, operating, Quebec district, returning to Montreal in 1918 in a similar capacity. He was appointed district engineer, operating, Quebec district, in 1919, and became engineer, maintenance of way, at Montreal on February 6, 1933, being transferred to Toronto on May 1, 1937.

Mr. Ballantyne was born on September 1, 1885, and entered railroad service on April 22, 1908, as a transitman on the Canadian Pacific at Montreal, Que. On March 1, 1912, he was appointed resident engineer at the same point, being transferred to Smith's Falls, Ont., on January 1, 1915, and to Schreiber, Ont., on November 28, 1916. After military service, Mr. Ballantyne returned to the Canadian Pacific as resident engineer at Schreiber on

Thomas B. Ballantyne

March 17, 1919, and on January 1, 1923, he became division engineer at Farnham, Que. He was advanced to assistant district engineer at Toronto on September 23, 1935, which position he held until his recent appointment as district engineer.

O. V. Derr, valuation and general office engineer of the Erie, with headquarters at Cleveland, Ohio, resigned on September 1, to enter private business and the position of valuation and general office engineer has been abolished. Mr. Derr was born at Needham, Mass., and received his education at the Stevens school and at Stevens Institute of Technology. He entered railway service in July, 1904, on the Baltimore & Ohio on location and construction work, and in September, 1906, he was appointed assistant engineer of the New York division. In July, 1908, he was appointed assistant engineer of the New Jersey and Lehigh divisions of the Lehigh Valley. In March, 1910, he re-entered the service of the B. & O., but left in December, 1910, to become field engineer of Eyre-Shoemaker, Inc., railroad contractors at Philadelphia, Pa. In February, 1912, he entered the service of the Erie as a resident engineer. During the war he served as a captain of engineers with the U. S. Army, and in August, 1919, he returned to the Erie as resident engineer. Mr. Derr was promoted to general office engineer of the system in June, 1929, and in April, 1931, he was advanced to valuation and general office engineer.

Track

W. A. Gunderson, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Little Rock, Ark., has been transferred to Pratt, Kan., with jurisdiction from Herrington, Kan., to Liberal, succeeding **J. H. Logan.**

Harry B. McColgan, Jr., assistant roadmaster on the Norfolk & Western, with headquarters at Portsmouth, Ohio, whose appointment as roadmaster at Wilcoe, W. Va., was announced in the October issue, was born on May 25, 1901, at Norton, Va. Mr. McColgan attended Virginia Military Institute, graduating in 1924, and entered railway service with the Norfolk & Western in the engineering department on June 23 of the same year. On November 15, 1936, he was promoted to assistant roadmaster at Crewe, Va., being transferred to Portsmouth on May 15, 1937.

Charles Trusty, whose retirement as track supervisor on the Southern, with headquarters at Somerset, Ky., was announced in the October issue, was born in Casey County, Ky., on January 12, 1873, and entered railway service on the Cincinnati, New Orleans & Texas Pacific (part of the Southern) on July 3, 1888, as a section laborer. In 1893, he was promoted to assistant extra gang foreman, and on December 1, 1898, he was advanced to section foreman at Kings Mountain, Ky. Mr. Trusty subsequently served as extra gang foreman and section foreman until February 15, 1921, when he was promoted to track supervisor, the position he held at the time of his retirement.

Lawrence Coffel, whose retirement as track supervisor on the Chicago & Eastern Illinois, with headquarters at Momence, Ill., was reported in the October issue, was born at Paris, Ill., on July 26, 1873, and entered railway service on April 18, 1891, as a section laborer on the St. Louis, Vandalia & Terre Haute (now part of the Pennsylvania). On May 19, 1895, he was promoted to section foreman at Dennison, Ill., and on June 5, 1902, he was advanced to yard foreman. He was promoted to extra gang foreman on June 5, 1903, but on June 22, 1905, he left the Vandalia to go with the C. & E. I. as a general foreman. Mr. Coffel was advanced to track supervisor on January 16, 1906, and held that position until his retirement.

G. A. Olson, track supervisor on the Chicago, Burlington & Quincy, has been promoted to roadmaster, with headquarters at Central City, Neb., succeeding **Andrew Ibson,** whose retirement on October 1, was announced in the October issue. Mr. Ibson was born at Thisted, Denmark, on September 24, 1868, and entered the service of the C. B. & Q. on April 5, 1888,

as a section laborer at Minden, Neb., later serving as a section laborer at Oxford, Neb. In 1889, he was promoted to section foreman on the McCook division, and in 1895, he was advanced to extra gang foreman on that division. Mr. Ibson was advanced to roadmaster with headquarters at Lincoln, Neb., in 1902, and in the fall of 1909, he was transferred to Central City, Neb.,

Arthur M. Loveless, whose promotion to track supervisor on the Chicago & Eastern Illinois, with headquarters at Chicago Heights, Ill., was announced in the October issue, was born at Browntown, Ill., on March 17, 1885, and entered railway service on August 1, 1908, as section laborer on the C. & E. I. On May 15, 1909, he was promoted to relief section foreman, but left the C. & E. I. on January 1, 1910, to go to Oklahoma, where he served several months on the Chicago, Rock Island & Pacific at Okarche, Okla. He returned to the C. & E. I. on September 1, 1911, as a section foreman, and on May 1, 1913, he was promoted to extra gang foreman. On March 12, 1923, he was appointed track repairman, and on June 20, 1932, he was promoted to welding foreman, and served in that capacity and as section foreman at Terre Haute, Ind., until his recent promotion.

Stuart S. Humphrey, assistant supervisor of track of the Mohawk division of the New York Central, with headquarters at Oneida, N.Y., has been promoted to supervisor of track of sub-division No. 18 of the St. Lawrence division, with headquarters at Gouverneur, N.Y., effective October 1, to succeed **P. Monahan. R. S. Fonda,** assistant supervisor of track of Sub-Division No. 23 of the Syracuse division, with headquarters at Canandaigua, N.Y., has been transferred to Oneida to relieve Mr. Humphrey. **William DeVries,** an extra gang foreman, has been appointed assistant supervisor of track at Canandaigua, to succeed Mr. Fonda.

Mr. Humphrey was born in 1896 at Oriskany, N.Y., and entered railway service with the New York Central in 1918, as a timekeeper on the Mohawk division. Two years later, he was advanced to assistant track foreman on the same division and on May 1, 1924, he was promoted to track foreman. On August 1, 1929, Mr. Humphrey was further promoted to assistant supervisor of track, with headquarters at Oneida.

O. Totland, section foreman on the Canadian Pacific at Lanigan, Sask., has been promoted to roadmaster of the Melfort subdivision, with headquarters at Lanigan, replacing **V. H. Carruthers,** whose promotion to division engineer at Winnipeg, Man., is announced elsewhere in these columns. **O. Erickson,** relieving roadmaster at Macleod, Alta., has been promoted to roadmaster, with headquarters at Manyberries, Alta., relieving **G. E. Baines,** who has been transferred to Consul, Sask., succeeding **H. Olson,** who, in turn, has been transferred to Macleod, to replace **Johan R. Sjobeck,** who retired September 1, on account of ill health.

Mr. Sjobeck was born at Loshult, Sweden, on May 17, 1882, and entered railway service on May 6, 1905, as a sectionman on the Canadian Pacific. He was later promoted to section foreman and extra gang foreman, and served in that capacity between Fort William, Ont., and Ignace, Ont. In July, 1913, he was transferred to Coronation, Alta., and was later promoted to roadmaster at that point. He subsequently served as roadmaster at Bassano, Alta., Irricane, Alta., Saskatoon, Sask., Lomond, Alta., and Macleod, at which latter point he was located at the time of his retirement.

John P. Mumford, whose promotion to track supervisor on the Southern, with headquarters at Dayton, Tenn., was announced in the October issue of *Railway Engineering and Maintenance*, was born at Huntington, W. Va., on September 21, 1911, and attended Marshall College and the University of Kentucky. He entered railway service in the summer of 1925, as a messenger boy on the Chesapeake & Ohio at Ashland, Ky., and served in that capacity again in the summer of 1927. He was appointed a chainman with the Kentucky Highway Department in July, 1928, and in July of the following summer he was appointed a rodman on location work for the C. & O., returning to school in October of that year. In July, 1930, he was again appointed a rodman on the C. & O., this time on tunnel elimination work, and he again returned to school in October. On July 1, 1935, after leaving the University of Kentucky, he was appointed a rodman in the office of the chief engineer of maintenance of way and structures of the Southern at Cincinnati, Ohio, and on November 1, 1936, he was promoted to junior engineer in that office. Mr. Mumford was appointed assistant supervisor of track, with headquarters at Birmingham, Ala., on August 1, 1937, and on June 15, 1938, he was appointed assistant supervisor of bridges and buildings at that point, the position he held at the time of his recent promotion.

C. C. Mullen, whose promotion to track supervisor on the Southern, with headquarters at Huntingburg, Ind., was announced in the October issue of *Railway Engineering and Maintenance*, was born in Washington County, Md., on August 19, 1908, and graduated from the Baltimore Polytechnic Institute in 1927. He first entered railway service as a track apprentice on the Baltimore & Ohio on June 20, 1927, and on December 31, 1927, he was promoted to apprentice assistant foreman. On July 1, 1928, he was advanced to apprentice foreman, and on July 1, 1929, he was promoted to apprentice assistant supervisor. He was advanced to assistant track supervisor on January 1, 1931, and on May 9, 1932, he was appointed a chainman in the engineering department, with headquarters at Grafton, W. Va. From July, 1932, to December, 1933, he was employed variously as a rail welder helper, a trackman and an extra gang foreman. On December 9, 1933, Mr. Mullen left the service of the B. & O. to work as a chainman and later as a rodman for the U.S. Coast and Geodetic Survey, but in April, 1934, he returned to railway service, this time with the Pennsylvania, as an assistant track foreman and later as a rodman. On June 8, 1934, he left the Pennsylvania to accept appointment as lieutenant quartermaster, U.S. Army, and was on active duty at Fort Hoyle, Md., and New Cumberland, Pa., until August 1, 1937, when he returned to the Pennsylvania as a rodman. On September 26 of that year, he left the Pennsylvania to become assistant bridge and building supervisor on the Southern at Hattiesburg, Miss., and on May 1, 1938, he was appointed assistant to the roadmaster at Somerset, Ky., the position he held until his recent promotion.

Bridge and Building

J. A. Lewis has been appointed bridge and building inspector on the Syracuse division of the New York Central, effecttive October 1, with headquarters at Rochester, N.Y., to succeed **B. P. Van Dusen,** who has retired.

J. G. Hunter, assistant roadmaster of the Norfolk division of the Norfolk & Western, with headquarters at Crewe, Va., has been promoted to supervisor of bridges and buildings of the Radford division, with headquarters at Roanoke, Va., succeeding **J. R. Altizer,** whose appointment as assistant superintendent is noted elsewhere in these columns. **A. C. Tinsley,** assistant supervisor of bridges and buildings of the Pocahontas division, with headquarters at Bluefield, W. Va., has been promoted to supervisor of bridges and buildings of the Norfolk division, with headquarters at Crewe, to succeed **H. E. Guill,** who has retired. **G. W. Carbaugh,** carpenter foreman at Bluefield, has been promoted to assistant supervisor of bridges and buildings at the same point, to succeed Mr. Tinsley.

James R. Hartwell, whose retirement as supervisor of bridges and buildings on the Chicago & North Western, with headquarters at Pierre, S.D., was reported in the October issue, was born at Eldora, Iowa, on May 26, 1868, and entered the service of the North Western on July 6, 1889, as a helper in a carpenter gang. On November 4, 1889, he was transferred to a bridge gang at Wall Lake, Iowa, and on October 1, 1891, he was promoted to foreman. On June 1, 1906, he was transferred to Pierre and worked on bridge construction during the building of the Pierre to Rapid City, S.D., line. When the line was completed in 1908, he was advanced to supervisor of bridges and buildings, with headquarters at Pierre, the position he held until his retirement.

Obituary

Henry S. Fleming, consulting engineer and president of the Louisiana Southern, with headquarters at New York and New Orleans, La., died of a stroke on October 19, at his home in Bronxville, N.Y., after an illness of two weeks.

Joseph E. Murphy, division engineer of the Galesburg division of the Chicago, Burlington & Quincy from 1900 to 1905 and office engineer on the staff of the chief engineer at Chicago from 1906 to 1910, died in Denver, Colo., on September 27, after a year's illness.

Association News

Wood Preservers Association

The Executive committee met at Chicago on October 18 with every member present. Extensive consideration was given to the completion of plans for the thirty-fifth annual convention which will be held at the Hotel Willard, Washington, D. C., on January 24-26, 1939.

Roadmasters Association

Following the conclusion of the convention on September 22, a meeting of the Executive committee was called by President Peterson to organize work for the ensuing year. Arrangements were made to issue a call for volunteers for committee work as heretofore. The Hotel Stevens was selected as the headquarters for the next annual convention to be held on September 19-21, 1939.

Maintenance of Way Club of Chicago

Are You Preparing for Winter, and How? was the subject of a paper which I. H. Schram, engineer maintenance of way, Erie, presented before 65 members of the Club, at its first meeting of the year, on October 24. The next meeting will be November 28.

American Railway Engineering Association

Bulletin 405 for September and October has been mailed to all members. This bulletin contains the report of the Electrical Section and a monograph by F. M. Graham, assistant engineer standards, Pennsylvania, on Damage to Wooden Crossties from Tie Plate Penetration and Abrasion. All of the reports, except one, for bulletin 406 for November are now in the hands of the printer. This bulletin will contain reports of the committees on Standardization, Signals and Interlocking, Electricity, Clearances, Uniform General Contract Forms and Economics of Railway Location and Operation.

Tentative plans have been made for a joint meeting of the Board of Direction and the Nominating committee to be held some time in November or early in December, the date and place of the meeting not yet decided.

Eight committees held meetings during October as follows: Highways, at Chicago, on October 4; Iron and Steel Structure, at Washington, D. C., on October 6-7; Railway Location and Operation, at Ann Arbor, Mich., on October 6-7; Water Service, Fire Protection and Sanitation, at Chicago, on October 18; Wood Preservation, at Chicago, on October 19; Buildings, at Chicago, on October 19-20; Masonry, at Chicago, on October 26-27; and Economics of Railway Labor, at Birmingham, Ala., on October 27.

Four committees have arranged for meetings during November, these being, Ties, at St. Louis, on November 4; Roadway, at Chicago, on November 11; Records and Accounts, at Roanoke, Va., on November 15-16 (tentative); and Track, at Chicago, on November 16.

Tie Association

At a meeting of the Executive committee of the Railway Tie Association at Memphis, Tenn., on September 12, committees were appointed to study (1) changes that occur in the dimensions of crossties during the seasoning period; (2) manufacturing practice to accumulate data, figures and other information showing different methods of manufacturing crossties, end-trimming, etc.; (3) the moisture gradient as a determining factor in the treatment of crossties; and (4) the checking and splitting of ties. A committee was also appointed to study the possibility of elaborating the statistical service.

Metropolitan Track Supervisors Club

With 65 members and guests in attendance, the first meeting of the season was held at the Hotel McAlpin, New York, on October 20. The speaker was J. G. Hartley, assistant engineer of the Pennsylvania, who presented a paper on Methods of Elimination of Rail Corrugations. During the meeting a proposal was advanced for broadening the name and scope of the club, but it was decided to carry this subject over for further consideration at the next meeting.

In accordance with previous practice of the club, the next meeting will be held on the afternoon of the same day on which the New York Railroad Club holds its annual dinner. While the speaker has not yet been announced, it is expected that the subject will deal with the recent floods and hurricane in New England.

Supply Trade News

General

W. G. Dixon and Associates, St. Louis, Mo., have been appointed agents for the sale of welders and electrodes in St. Louis of the **Harnischfeger Corporation,** Milwaukee, Wis., to succeed **C. D. Hicks & Co.** The latter organization will, however, continue to handle the sale of cranes, hoists and excavators.

Personal

John R. Johnston, manager of sales of the Milwaukee district of the Carnegie-Illinois Steel Corporation, has been appointed assistant manager of sales of the Chicago district.

Harry W. Finnell, manager of the Chicago branch of Fairbanks, Morse & Company, from 1923 to 1927, and since that time vice-president of the Phelps Dodge Copper Products Corp., died in New York on October 1 after a short illness.

W. F. Munnikhuysen, first vice-president of the **Wood Preserving Corporation,** Pittsburgh, Pa., has been elected president to succeed **A. W. Armstrong,** deceased. **J. P. Williams, Jr.,** president of the Koppers Coal Company, has been elected a director of the Wood Preserving Corporation.

Mr. Munnikhuysen was born in Bel Air, Maryland, and was graduated from Cornell University in 1915 with a degree in civil engineering. He joined the construction department of the Koppers Company in 1916 and was later transferred to plant operations. For several years he had charge of the Chicago sales office for the Koppers Construction Company until 1930, at which time he became vice-president in charge of the Connecticut Coke Company at New Haven, Conn. In May, 1935, he was elected vice-president of the Wood Preserving Corporation, with headquarters at Pittsburgh, Pa., which position he held until his recent election.

Trade Publications

Fairmont Motor Car—Fairmont Railway Motors, Inc., Fairmont, Minn., has published an eight-page, illustrated bulletin, known as No. 365, which features its A3 (series B) bridge and building and extra gang car. The bulletin discusses the various mechanical features of this car and includes a set of specifications.

Spray Painting Equipment—The complete line of industrial spray-painting and finishing equipment manufactured by the DeVilbiss Company, Toledo, Ohio, is described in condensed form in Catalog ID issued by this company. Full specifications on all standard items are included, as well as descriptions of equipment designed for particular finishing conditions.

Better Drainage—This is the title of a pamphlet issued by the Armco Culvert Manufacturers' Association, Middletown, Ohio, which traces the history of corrugated metal drainage pipe from the time it was invented in 1896 to the present. High points in the history of corrugated metal pipe, as brought out in this pamphlet, were the development of Armco Ingot iron in 1906, the introduction of paved invert pipe in 1925 and the development of asbestos bonded pipe in 1936.

Rock Drills—The Ingersoll-Rand Company New York, has issued an 80-page catalog covering its complete line of pneumatic rock drills and allied equipment, including jackhammers, paving, breakers, pile drivers track spike drivers, drifters, wagon drills, core drills, diamond drills, drill steel, grinders and sharpeners. This new catalog, profusely illustrated, represents one of the most complete tabulations of operating and physical characteristics of drills, drilling tools and associated equipment ever issued by the company. In addition to this class of material, the catalog also contains eight pages of information such as metric and heat conversion tables, friction of air in pipes and hose, horsepower required to compress given quantities of air to specified pressures, and compressor capacities required to operate from 1 to 70 drills.

TO RAILWAY SUPPLY MANUFACTURERS

"The Busy Man"

"Bill, why is it that we're getting so little business from the .... Railway? Aren't you following them? How long since you called on the chief engineer?" asked the sales manager of a railway supply company.

"I saw him only last week," replied the district sales representative, "but I didn't get very far."

"What's the matter?"

"He's too busy. Take last week as an illustration. He was out on the line for several days and I waited over to see him. And so did a lot of other salesmen."

"I suppose so."

"Yes, and when I finally got in, he wasn't in any mood to listen to me, for there was a stack of mail in front of him a foot high. He tried to be courteous while I told our story but I could see that his mind was on that mail."

"That's natural, I suppose."

"And to make matters worse, just as I was getting him interested, the president called for him to go over some budget matters and he didn't get back until after 5 o'clock."

"You stayed over until the next day, didn't you?"

"No, for his chief clerk told me that he'd be tied up all that day with some of his men whom he'd called in for a staff meeting."

"He must be a busy man."

"He is just that. These railway men are working under so much pressure these days that it's next to impossible to see them and when you do get in, they're so busy that you feel guilty taking their time."

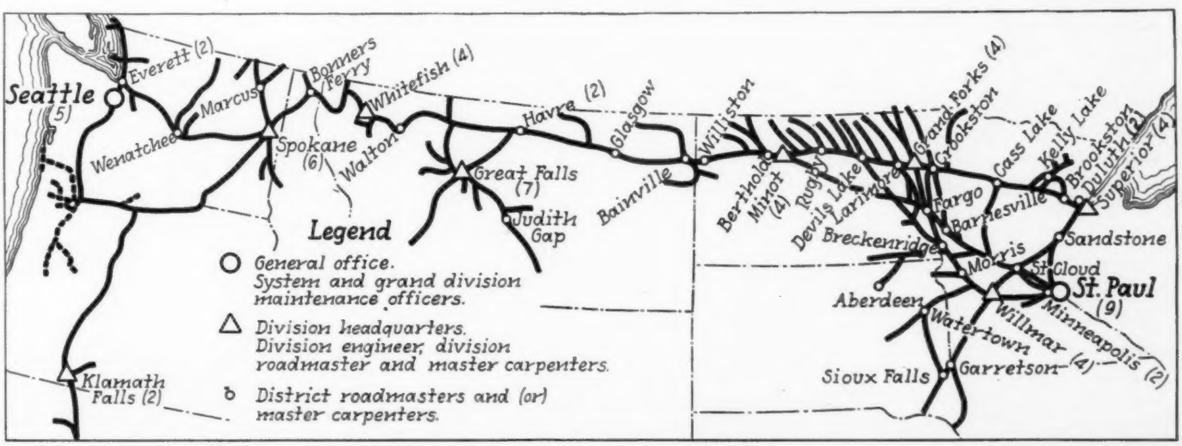
"What's the solution?"

"Why not present our story in the advertising pages of Railway Engineering and Maintenance? He takes that magazine home with him and reads it there when he is at leisure, away from the telephone and the pressure of the office. He'll see our story there—and while reaching him, we'll reach all his staff assistants, his division engineers, his roadmasters and his bridge and building supervisors, for they're all getting the magazine, together with his brighter and more alert foremen."

"In other words," replied the sales manager, "you mean that through advertising we'll not only reach the chief engineer but all of his subordinate officers as well?"

"That's it, boss. We'll cover the road."

"Bill, that's a swell idea."



Railway Engineering and Maintenance Goes Every Month to 83 Supervisory Maintenance Officers of the Great Northern at **2 General Offices, 8 Division Headquarters and 30 Other Supervisors' Headquarters,** Scattered All the Way from Duluth, Minn., to Seattle, Wash., and Klamath Falls, Ore. This Magazine Also Goes to 58 Other Subordinate Officers Who Are in Training for Promotion to Supervisory Positions on These Lines.

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of RAILWAY ENGINEERING & MAINTENANCE published monthly at Chicago, Illinois, for October 1, 1938.

State of Illinois }
County of Cook } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Elmer T. Howson, who, having been duly sworn according to law, deposes and says that he is the editor of the RAILWAY ENGINEERING & MAINTENANCE and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Simmons-Boardman Publishing Corp., 105 West Adams St., Chicago, Ill.; Editor, Elmer T. Howson, 105 West Adams St., Chicago, Ill.; Managing Editor, Neal D. Howard, 105 West Adams St., Chicago, Ill.; Business Manager, F. C. Koch, 30 Church Street, New York, N.Y.

2. That the owners are: Simmons-Boardman Publishing Corporation, 30 Church Street, New York, N.Y.; Stockholders of 1 per cent or more of the total amount of stock are: I. R. Kerfoot, 15 Hillcrest Dr., Pelham Manor, N.Y.; P. A. Lee, Hopatcong, N.J.; Henry Lee, Hopatcong, N.J.; E. G. Wright, 398 N. Walnut Street, E. Orange, N.J.; S. O. Dunn, 105 West Adams Street, Chicago, Ill.; C. E. Dunn, 3500 Sheridan Blvd., Chicago, Ill.; L. B. Sherman, 375 Sheridan Road, Winnetka, Ill.; Mae E. Howson, 105 West Adams Street, Chicago, Ill.; B. L. Johnson, 6949 Bennett Avenue, Chicago, Ill.; The Chase National Bank of the City of New York and Prudence Whitney Mallory, as Trustees under the last will and testament of Robert Mallory, Jr., deceased; Spencer Trask & Company, 25 Broad Street, New York, N.Y. General partners of Spencer Trask & Company are: Edwin M. Bulkley, Walnut Street, Englewood, N.J.; Acosta Nichols, Cold Spring Road, Oyster Bay, N.J.; Cecil Barret, Carlyle Hotel, New York, N.Y.; C. Everett Bacon, 16 Erwin Park, Montclair, N.J.; F. Malbone Blodget, 65 Patterson Ave., Greenwich, Conn.; Arthur H. Gilbert, 440 Park Ave., New York, N.Y.; Henry S. Allen, 407 Highland Ave., Orange, N.J.; William R. Basset, Old Church Road, Greenwich, Conn.; William Kurt Beckers, South Salem Road, Poundridge, N.Y.; Reginald C. Foster, 484 Charles River St., Needham, Mass.; Edwin M. Bulkley, Jr., 21 Sturgis Road, Bronxville, N.Y.; S. Bayard Colgate, Center Street, Orange, N.J., Limited Partner; Henry A. Colgate, New Vernon, N.J., Limited Partner.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

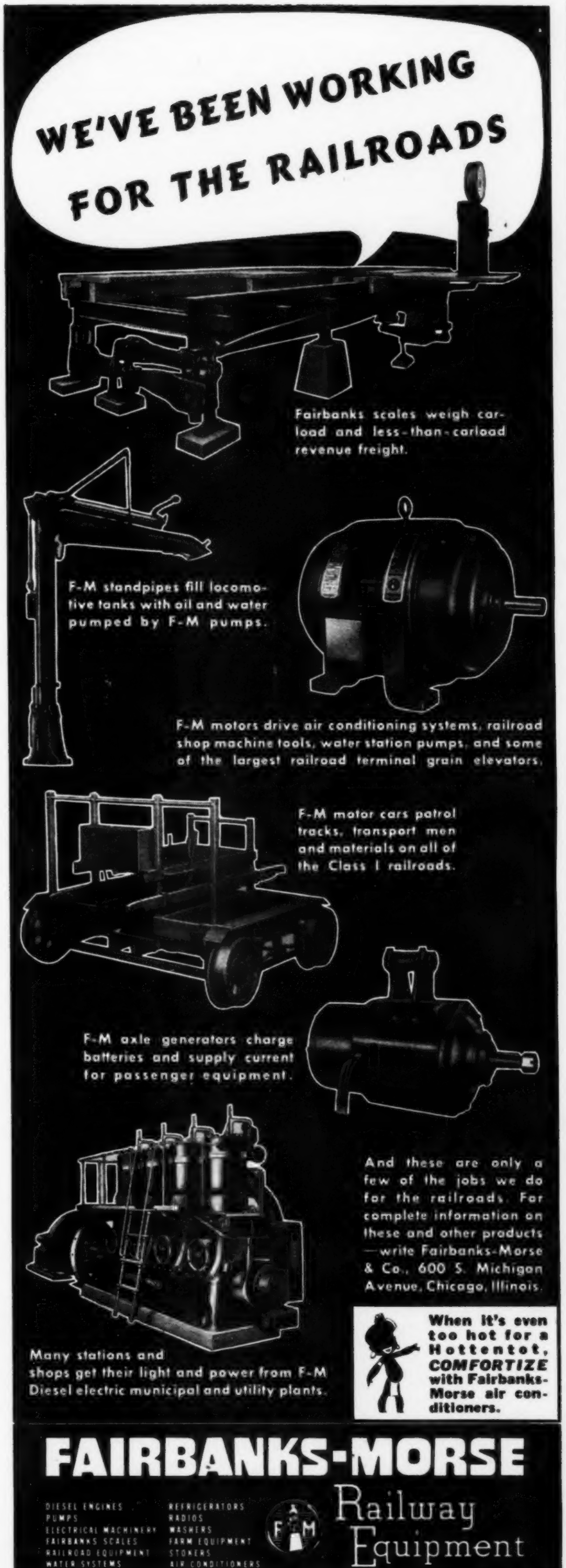
4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

ELMER T. HOWSON,
Editor.

Sworn to and subscribed before me this 23rd day of September, 1938.

ANNE A. BOYD.

(SEAL) (My commission expires Dec. 10, 1939.)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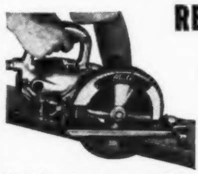

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